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The Electrical Review

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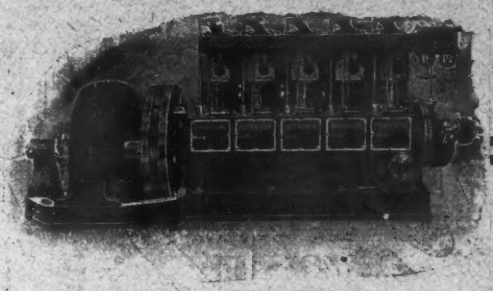

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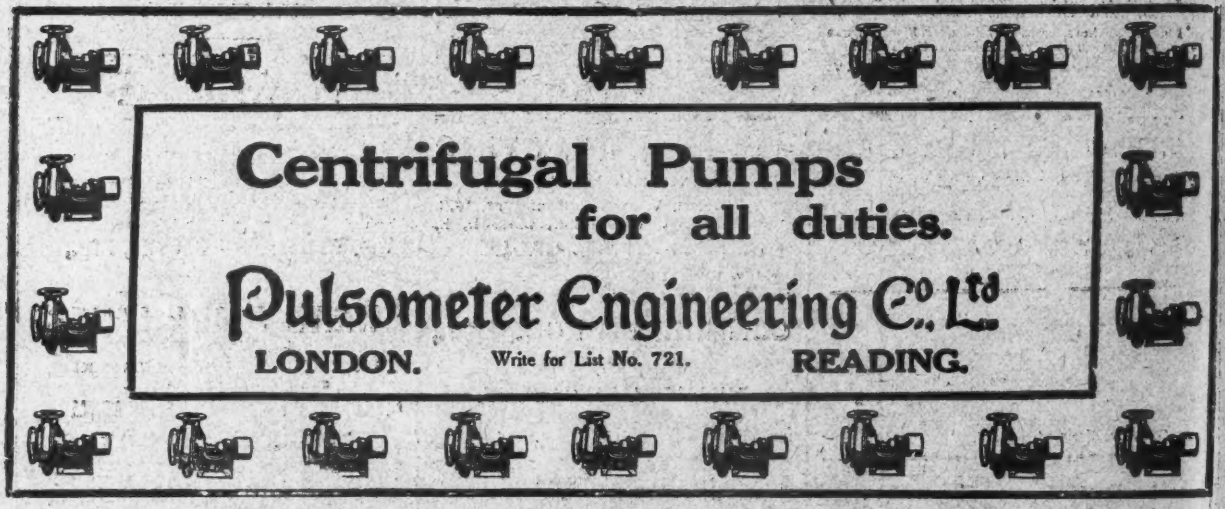

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THE

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BREAKDOWNS OF GERMAN PLANT.

THAT in the future German competition with British electrical manufacturers, not only in this country, but throughout the British Empire, shall be reduced to the vanishing point, is a sentiment which is cherished by every patriotic Briton; it is impossible that anyone of us who has lived through the past two years should regard the German nation otherwise than as a race of murderers and heartless savages, with whom friendly intercourse is inconceivable. But not only on the grounds of humanity and patriotism is German plant taboo—there are also important technical and commercial objections to it, of which the evidence has lately been rapidly accumulating. We have thought it desirable to bring together a number of instances in which disaster has resulted from its installation, as a warning to possible purchasers—for even if our Government summons courage to put in force the Paris Convention and exclude all enemy goods from our markets, there will still remain a considerable number of buyers in neutral countries whose orders will be eagerly sought by the Germans.

We have already reported the series of misfortunes suffered by Mr. T. H. U. Aldridge, electrical engineer to the Shanghai Municipal Council, as the penalty for installing German turbo-alternators on the score of quicker delivery. As Mr. Aldridge has frankly made public more complete particulars of the matter than are usually available in such cases, we have given, first, a *résumé* of his experience, from which it will be seen that three out of four German turbo-alternators, in the short space of three years, have come to grief.

As we briefly mentioned in our last issue, the local agents of the A.E.G. wrote to the Council with regard to Mr. Aldridge's report on the failure of the 5,000-KW. turbo-alternator, endeavouring to discredit his conclusions, and alleging that the turbine must have been run at an excessive speed, that the faults might have been due to defective switchgear, that the supervision was inadequate, that the set had been allowed to get out of balance and adjustment, and that the plant was not kept clean. Mr. Aldridge, however, in a detailed reply, pointed out that the agents had had nothing whatever to do with the contract, and remarked that the stator coils were loose in the slots, the switchgear was in good order, and the machine was running on the test tank with the automatic switches disconnected when it broke down. He stated also that extraordinarily rapid deterioration had taken place in the turbine, and that if the speed had been excessive it would have indicated that the emergency governor was ineffective; there was, however, no evidence that it had ever raced. In his opinion, the condition of the blades was such that their useful life could not be more than two or three years at the most, and already, owing to their condition, the steam consumption of the machine had increased above the guarantee. The A.E.G. machines were under the supervision of the same staff as the six British turbo-alternators, which had done excellent

service for five to nine years, and showed not the least sign of erosion or deterioration of the blading.

It will be noticed that the majority of the failures and defects described in our later pages took place in connection with A.E.G. machines, though other makes are also represented; moreover, in most cases the faults were due to errors in *design*, not so much from a theoretical as from a practical standpoint. That is to say, whilst the German designers apparently knew what should be aimed at, they did not know how to attain the desired ends without introducing intricacies and complexities of construction which, from the user's point of view, as pointed out by Mr. Bernard Price, far more than outweighed the slight gain in efficiency or output that resulted. Now, it is precisely in the possession and use of "the engineering eye" that the British designer excels; he knows how far to go in the direction of refinement, and where to draw the line and effect a judicious compromise between the theoretically best and the practically expedient, with a bias, perhaps, towards durability and simplicity. This trait is by no means confined to electrical engineering; it is freely manifested also in connection with civil and mechanical engineering, and is one of the chief factors which have built up the reputation of British work as unexcelled in point of longevity, solidity, and reliability. But—and this is most important—in order to secure these desirable qualities some sacrifice of efficiency or rating, or both, and some increase in weight and cost, is unavoidable, and hence the German machine is enabled, on the face of things, to appear the cheaper, whereas, in point of fact, the British machine is a far better bargain, with a greater margin of temperature rise, reliability, and accessibility for inspection and repair. That there are exceptions we do not deny: not every British designer is a heaven-born genius, and not every workman is competent and conscientious. But we do claim that, taken by and large, British plant is the better, and the portentous list of failures of German plant that we have brought together supports this contention. We have by no means exhausted the possibilities of the subject; engineers who have been bitten are not proud of their scars, and are apt to conceal them jealously. Mr. Aldridge has set a patriotic example, which others might well imitate, and we shall be glad to publish additional illustrations of the clay feet of the German colossus if they are forwarded to us.

Banks and A New Efficiency.

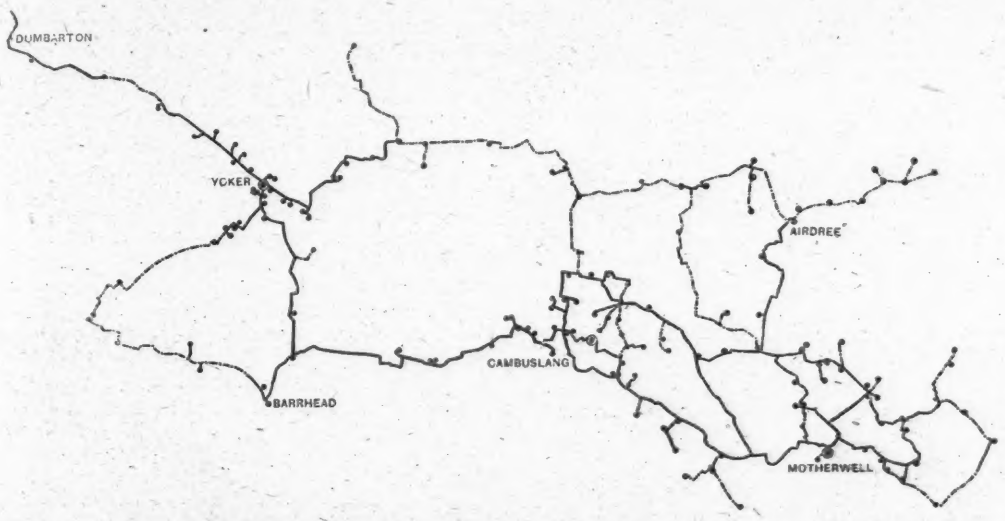
Owing to the heavy demands made upon the newspaper Press by war news, the address of the president of the Institute of Bankers, Mr. G. H. Pownall, has not received all the attention that it merits. It is a review of "current events of surpassing importance," and deals in the main with the relation of banking institutions to trade and industry. In reply to the demand that there should be substituted for our well-tried and successful system of banking, which has acquitted itself so admirably under the unprecedented conditions of world-war, another contrived to meet the dissimilar conditions of Germany, he contrasts English and German business methods, and shows that the British system has assumed its present character and methods according to the development that has been taking place in our local and industrial life. The tendency is for all businesses to become larger, and larger commercial enterprises demand larger banks. Organised competition, says Mr. Pownall, stands in the way of success of the small trader; the banker is not to blame. We have to recognise that manufacturing processes can only be carried out successfully on a large scale. "The facts of life compel this, and not the banker." He goes on to show, what our readers are perfectly familiar with, that in Germany large scale and controlled industry is the accepted basis of the business world. He tells us that the larger unit in business has come to stay because large-scale foreign competition can only be successfully met by bodies able to afford to resist the costly burden of attempts to crush them out of existence. "We, like Germany and the United States, are learning that production on a large scale is often the only efficient form of production." The German bank is in the habit of standing by the companies whose shares it has issued, and owing to its close connection with the industrial concerns its prosperity is bound up with that of industries which must suffer natural fluctuations of depression and inflation. It is questioned whether English traders and manufacturers would be prepared to submit to supervision. With control by the financial interest in Germany, the private will of the controlled establishment is gone. Mr. Pownall holds that it is in the interest of the community to preserve the huge fund of bankers' credit intact, liquid, but he goes on to show the possibilities that await skilfully handled development companies—not purely finance companies—to investigate the claims of new enterprises, and, without lessening the initiative of individuals, to secure that contracts abroad financed by British money are executed by British industry. "Adventurous banking . . . . is not banking . . . . it is utterly alien to the English system, or, indeed, to any system which involves dealing in deposits repayable at short notice." Quite legitimately, the president turns his searchlight upon "our defective trade methods," incidentally remarks that "now is the time to ensure the introduction of the metric system," alludes to our need for better technical education, and so on.

The address proceeds to dwell upon the vital importance to us of our export trade. "We must export to live. The moral is not despair, but a new national efficiency." We have to broaden our outlook. Mr. Pownall says that after the war we shall have no German competition to deal with in ruined Europe, but the neutral nations can, and will, compete everywhere, "and if our prices are high, they will do it effectively." Asking whether such a thing as this "new efficiency" is possible, and how we are to compete in the neutral markets of the world with neutrals who do not bear the burdens that we do, Mr. Pownall says that in the competitive commerce of the world efficiency not only in material, style, terms of payment, mode of touting for orders, but also in price, counts. "We can look only to increased efficiency in production . . . . to such improvements as will cheapen cost." Can increased production be secured without sacrificing the welfare of the working classes? "The economic truth that the interests of Capital and Labour are identical may be accepted as axiomatic." Mr. Pownall states that in foreign trade, prices are international, and in our competition with America, Japan, and Scandinavia we shall be hampered by increased cost of production while higher cost of production, but in a greater degree, will be true of Germany, France, Russia, and, possibly, Italy. "We must find a new efficiency if we are to compete in the free markets of the world." We gather that, in his opinion, perhaps the greatest service that a Trade Bank, as suggested by Lord Faringdon's Committee, can render to the country is to introduce method in our dealing with our foreign business affairs and to provide exact and practical information as to what is going on in the world outside our coasts. Mr. Pownall naturally looks at the whole matter from the banking standpoint. There have been so many criticisms of the banks from the traders' point of view that contributions of the present kind form interesting reading, and those who are studying national problems would do well to read the address in its complete form.

THE CLYDE VALLEY CO.'S NEW CAMBUSLANG POWER STATION.

In a recent issue we referred to the opening of the first section of the Clyde Valley Electrical Power Co.'s new power station near Cambuslang; the building and equipment of this plant, which has occupied a very short time, in fact, less than nine months, will enable the company to cater for the rapidly growing demands of the industrial area which it supplies. It is situated on the south bank of the River Clyde, near the village of Carmyle, the company having acquired by feu charter the old Clyde's Mill, together with its ancient water rights. Water from the river is used for condensing and make-up purposes, advantage being taken of the siphonic action due to the 5-ft. fall between the sealed circulating water outlet and the river intake to reduce the power required for circulating-water purposes to a minimum.

The first portion of the generating plant consists of one turbo-alternator of 5,000 kw. output at ·80 power factor, running at 1,500 r.p.m. The turbine is of the Rateau type, supplied by the British Westinghouse Co., who have already installed five practically similar machines at the company's power stations at Motherwell and Yoker.



The E.H.T. System of the Clyde Valley Electrical Power Co. (Overhead Transmissions shown Dotted.)

Steam is supplied at 200 lb. pressure from two three-drum land-type Babcock & Wilcox boilers, each having an evaporation of 33,000 lb. of water per hour. The boilers are equipped with chain-grate stokers, integral superheaters and Green economisers. A Lassen-Hjort water-softening plant is also installed, together with two turbine-driven centrifugal boiler feed pumps supplied by Messrs. Weir, the exhaust being utilised for the heating of the boiler feed water in the hot well. Each boiler is fitted with an electrically-driven "Sirocco" induced-draught fan, and one steel chimney, 80 ft. high, handles the waste gases from the two boilers.

The turbine set exhausts into a Weir surface condenser, operating in conjunction with dual air pumps of the same make, the circulating water being furnished by a vertical centrifugal pump made by Messrs. Drysdale, and situate in a dry well near the river intake, where a mechanically-operated water screening plant is provided.

The main generator is of the two-pole star-wound type with rotating field, and generates three-phase current at 11,000 volts and 25 cycles; a 60-volt exciter is direct coupled to the main generator shaft. The star point of the generator windings is brought out and connected to Merz-Price protective gear.

An electrically-driven "Sirocco" fan, situated immediately underneath, supplies cool air to the generator, drawing its supply from a "Sirocco" air washer

The control switchboard is at present of the simplest construction, consisting of one panel with syncroscope, voltmeters, power factor meter, ammeter, indicating or recording wattmeters. The outgoing feeders consist of ·15 sq. in. three-core E.H.T. paper-insulated, lead-covered and armoured cables. The generator and feeders are controlled by oil-break switches, with Merz-Price and overload trips, these switches, together with the bus-bars and isolating links, being placed in brick cubicles in the basement and close to the control switchboard.

The engine room bay is served by a 30-ton overhead electric travelling crane, supplied by Messrs. John Grieve and Co. The fuel for the plant comes forward on an elevated railway, the loaded wagons being tipped by a hydraulic ram into the coal hopper, or by-passed through a crusher. The coal is then delivered into a bucket-conveyor, which supplies the bunkers above the boilers. The company has under consideration a large coal storage scheme, with relative coal-handling plant.

The boiler, economiser and generator house buildings are of steel framework filled in with brick, a feature being the general effective natural lighting of the entire plant.

The power company's staff carried out the complete railway work, river work, and general building construction. The river work, which comprised the building of the necessary coffer dams, rebuilding in concrete and extending the main dam, as also the concrete work in connection with the river intake, &c., was carried out under the most adverse circumstances, the spring and summer of this year having been characterised by heavy floods and exceptional rainfall. A successful feature in the carrying out of the constructional work was the employment of women labour, some 20 per cent. of the labour employed on the railway sidings, foundations, and general work being of this nature. All the sand required in carrying out the building works was obtained from the station excavations, as also the puddle clay for the coffer dams; further, any excavated material from the foundations was fully utilised on site in the construction of the works' railway tracks.

All the plant and labour-saving devices used during the construction were electrically operated from the company's distribution system; and, to illustrate the low cost of operating such intermittent running plant electrically, it may be mentioned that the entire power costs of the 10-ton derrick crane used by the structural engineers in the erection of the building frame work was under £2 for the handling and placing in position of some 250 tons of steel work.

The whole of the work involved in the erection of the plant was carried out under the personal supervision of the company's general manager, Mr. David A. Starr, assisted by the chief engineer, Mr. D. M. Macleod, and staff.

The new power station is located in the centre of the company's E.H.T. distribution system, and approximately

halfway between the present generating stations. Already the company has derived considerable benefit on its distribution circuits through the starting-up of the new station, and Mr. Starr and his staff are to be congratulated on the rapid putting into commission of this station, and its satisfactory attendant results.

THE ROYAL DOCKYARD SCHOOLS.

[An Account of the Admiralty Method of Training Dockyard Apprentices.]

By P. H. S. KEMPTON, A.R.C.S., B.Sc.

The training of apprentices by the Admiralty, a report on which has recently been issued by the Board of Education,* has been carried on in H.M. Dockyard Schools since 1843. Reorganisations have, of course, taken place from time to time; changes in detail have been suggested by experience and a clearer realisation of the needs of the future, and to-day the Dockyard Schools are recognised as among the foremost technical institutions in the country. But the system of entry of dockyard apprentices by open competition and their training in educational subjects in Dockyard Schools dates back nearly three-quarters of a century.

In issuing the report under review, the Board of Education "realise that among the problems which are at the present time engaging the attention of employers, education authorities, and teachers, few can compare in importance and extent with those relating to the proper training of industrial workers and to the provision of suitable means for the development and advancement of workmen of special ability. These objects have been attained with conspicuous success by the Admiralty scheme, which the Board's Inspectors have found to be too little known in the country. The Board are, therefore, glad to be able, with the consent of the Admiralty, to issue this descriptive account of the system." The report deals successively, and in considerable detail, with (1) the aim of the scheme, (2) its chief characteristics, (3) entrance examination, (4) organisation and curriculum, (5) results attained. It has been prepared for the Board of Education by H.M.I., Mr. G. A. Baxandall.

There are at present seven Dockyard Schools established in our naval ports: at Portsmouth, Devonport, Chatham, Pembroke Dock, Sheerness, Haulbowline and Rosyth. All these schools are under the Department of the Director of Naval Education (Sir Alfred Ewing, K.C.B.), are staffed by University graduates and technical experts, and are adequately equipped for the instruction of apprentices in advanced scientific and mathematical subjects. The schemes of training in all the schools are identical, the examinations are common to them all, and general lists are issued each year upon which promotions, rewards, and appointments are based.

From the inception of the scheme to the present day the main objects of the Dockyard Schools have been, first, to provide men qualified for employment as draughtsmen and subordinate dockyard officers; secondly, to train a body of men from which to recruit the designers of ships for the Royal Navy; and thirdly, to increase the efficiency of the dockyard workmen as a whole.

After reviewing the history of the schools from their modest beginnings, through their complete reorganisation in 1905, to their present efficient condition, the report summarises the chief characteristics of the scheme under the following headings:—

1. Admission by open competition to six-year apprenticeship; choice of trade is dependent on position on entry list.

2. Compulsory attendance at the Dockyard School for at least one year; classification into Upper and Lower Schools by position on entry list, Upper School attending on two afternoons and three evenings and Lower School on one afternoon and two evenings per week.

3. Annual rejection from the school by a weeding-out process, which promotes about half the pupils in each year to the next year of the course and rejects the rest. The report emphasises the importance of the keen competition arising from this weeding-out process, remarking that:—"It may safely be assumed that those apprentices in the Upper School who survive it represent material of first-rate ability."

4. Admiralty Prizes are awarded for inter-school competition, and sets of valuable text-books are lent to all apprentices for their school course, and retained by those exceeding half marks in the final examination.

5. Practical training—each apprentice is placed in the charge of a competent workman as instructor, and all students who pass into the fourth-year school course are allowed to spend one year of their apprenticeship in the drawing offices of their respective departments.

6. Prospects open to apprentices—Cadetships in Naval Construction to Greenwich Royal Naval College, and subsequent appointment as Members of the Royal Corps of Naval Constructors. Two or three such awards are made each year on the results of the school examinations.

"Apprentices who fail to win Admiralty Scholarships usually compete for Royal Scholarships, and Whitworth Exhibitions and Scholarships, which are awarded on the results of the examinations held by the Board of Education, and in recent years they have been remarkably successful in securing these awards. The successful candidates for such scholarships obtain leave from the Admiralty to continue their education at approved institutions—such as the Imperial College of Science and Technology, or other institutions of University rank—where, in virtue of their previous training, they are frequently allowed to omit a considerable part of the three or four years' course and devote part of their time to post-graduate and research work. They afterwards return to the dockyards, or find posts in other Government Departments or private firms; a few of them enter the teaching profession."

The organisation and curriculum of the schools is described in great detail. A good idea of the scope of the work done can be obtained from the table set out below, which is taken from the report:—

First Year.	Second Year.
For Apprentices of all Trades.	*For Apprentices of all Trades.*
English.	English.
Practical Mathematics.	Practical Mathematics.
Elementary Science.	Mechanics.
Mechanics.	Heat and Metallurgy.
	Mechanical Drawing.
Third Year.	**Fourth Year.**
For Apprentices of all Trades.	*For Apprentices of all Trades.*
Practical Mathematics.	Practical Mathematics.
Applied Mechanics.	Applied Mechanics.
Electricity.	Electricity.
Mechanical Drawing.	Mechanical Drawing.
	Heat and Metallurgy.
Professional Subjects.	*Professional Subjects.*
For Engine Fitter Apprentices and those of Kindred Trades, and Electrical Fitters.	*For Engine Fitter Apprentices and those of Kindred Trades.*
Steam and Heat Engines.	Steam and Heat Engines.
	General Engineering.
For Engine Fitter Apprentices and those of Kindred Trades.	*For Electrical Fitter Apprentices only.*
General Engineering.	Electrical Engineering.
For Shipwright Apprentices and those of Kindred Trades.	*For Shipwright Apprentices and those of Kindred Trades.*
Naval Architecture.	Naval Architecture.

The course in English, which covers the first two years, occupies an important place in the training of the young engineer or shipwright. Besides developing the power of expressing ideas clearly in writing, it serves to continue the cultural education of the apprentices (a notable omission from many otherwise commendable schemes of further education). The apprentices are introduced to good literature, and by including a special period of History on the lines of Green's "Short History of the English People," a thoughtful study and appreciation of the social, constitutional and intellectual advance of the nation is induced.

* Educational Pamphlets, No. 32: "The Admiralty Method of Training Dockyard Apprentices." Board of Education. August, 1916.

The mathematical work is continued throughout the whole course, and by the end of the second year considerable progress has been made with the calculus. In the third and fourth years, both branches of the calculus, co-ordinate geometry of two and three dimensions, and differential equations, with applications to physics and engineering, are studied. To quote from the report: "The standard attained is exceptionally high, and is probably not exceeded in any existing educational institution, if regard is had to the age of the boys and the schools from which they are drawn, and to the fact that they are receiving a part-time training. There can be little doubt that the excellent mathematical training which the apprentices receive in the Dockyard Schools accounts for the rapid progress which they are able to make in other engineering subjects, and for their confidence and power in attacking problems."

The scientific work begins in the first year with a general course, including physical measurements, heat, light, magnetism and electricity, mechanics, and chemistry. In the second year the mechanics course is continued, and heat and metallurgy are studied in some detail, the latter subjects receiving further and practical treatment in the fourth-year course. In the third and fourth years, all apprentices receive a course in technical electricity, and in the case of electrical apprentices this develops into electrical engineering in the fourth year. All apprentices also receive instruction in mechanical drawing from their second year onwards, and trial drawings connected with their respective trades, and made in the drawing-offices from their own measurements, form part of the final fourth-year examinations.

The bulk of this instruction is given by the permanent staff of the schools, but courses of lectures are also given by other dockyard officers on professional subjects—*e.g.*, electrical engineering and naval architecture—and in this way the instruction at the schools is kept in intimate connection with the actual working practice of the yards.

The school year extends from early in August till the middle of June, and, during this time, apprentices attend the Upper School on two afternoons a week for three hours, and three evenings for two hours. They thus receive 12 hours' school instruction a week: six during working hours, and six outside working hours. The Lower School apprentices attend on one afternoon a week for three hours, and two evenings for two hours, thus receiving seven hours' school instruction a week. The complete courses in the Upper and Lower Schools extend over four and three years respectively, and except that the Lower School work is of a more elementary character, the two courses run practically parallel. Each Upper School class spends about two hours a week in the school laboratory; no laboratory instruction is given to Lower School apprentices.

It may be confidently claimed that to our Dockyard Schools must be attributed a very considerable measure of Britain's present naval pre-eminence. This scheme, which is British in origin and democratic in character, has supplied the nation with a large proportion of its distinguished naval architects and engineers; Sir F. H. Biles, D.Sc., Sir A. J. Durston, K.C.B., Frank Elgar, LL.D., F.R.S., Sir J. B. Marshall, K.C.B., Sir H. J. Oram, K.C.B., F.R.S., Sir Wm. Pearce, Sir Edward Reed, Sir Wm. Smith, Sir Philip Watts, K.C.B., F.R.S., and Sir Wm. White, K.C.B., were all dockyard apprentices, and have all passed through one of H.M. Dockyard Schools. And the system which has produced such a galaxy of talent and enterprise is still yielding results which augur well for the future. During the past few years a remarkable succession of Whitworth, Royal, and National Scholarships has fallen to dockyard apprentices, and it can be prophesied with considerable certainty that dockyard apprentices will continue to play an important part in maintaining Britain's supremacy in naval and general engineering and shipbuilding.

The Board of Education are to be congratulated on giving to this highly-successful system a wider publicity, and Mr. Baxandall on the production of such a detailed and accurate account of the scheme. We would heartily commend this report to the notice of all who are interested in the training of apprentices, and especially to Education Committees and employers of labour, to whom all matters concerning technical education must now appeal as urgent and vital.

BREAKDOWNS OF GERMAN PLANT.

BELOW we give particulars of a number of failures of German plant, to which we refer in our leading columns to-day:—

SHANGHAI.—In his report for the year 1915, Mr. T. H. U. Aldridge, electrical engineer to the Municipal Council, said that two 2,000-KW. German turbo-alternators that were installed two years ago at the Riverside station were accepted because the tenders were, on the face of things, the best offers received. They turned out, however, a very bad bargain, for serious breakdowns took place, and at one critical period no less than two-thirds of the plant was out of commission, owing to the development of serious defects. Unsuitable material had been used for the blading, and mechanical defects were also revealed, and almost simultaneously with the blade troubles a serious electrical burn-out took place. On the other hand, six British turbo-alternators aggregating 4,200 KW., which had been running for five to nine years, had proved to be so good that the average cost of repairs was less than £40 each per annum, whereas the two German sets, which had been running less than two years, had cost respectively £318 and £267 per annum for repairs, in addition to the loss of revenue whilst they were under repair.

German transformers also showed marked inferiority to British and American ones. But worse was to come. In June last, one of the two 5,000-KW. German turbo-alternators which were installed last year broke down very badly. Some of the stator coils were short-circuited or earthed, causing a very bad burn-out, the copper conductors and iron laminations being entirely fused together, whilst the insulation of half of the end windings was completely burnt off. The damage would require months to make good, and even then, Mr. Aldridge felt, it was doubtful whether the machine could be regarded as a reliable piece of apparatus. Thus three out of the four A.E.G. turbo-generators have broken down. While the actual cause of the breakdowns is uncertain, there was no doubt that rapid deterioration had taken place, both in the stator-winding and in the turbine blading, the latter being badly eroded. Mr. Aldridge's conclusion was that the turbine plant was most unsatisfactory, and that the continuity of the public supply was jeopardised thereby.

SYDNEY.—In 1913 the City Council purchased an A.E.G. turbo-alternator through the Australian Metal Co.; it broke down in the following year, owing to defects in the turbine.

MELBOURNE.—A 5,000-KW. A.E.G. turbo-alternator was delivered to the Melbourne Electric Supply Co., Ltd., just before the outbreak of war—one of two sets ordered from Germany for the sake of quick delivery, the second of which was not delivered. Within three weeks of the set being put in service a shut-down took place, and it was found that the second diaphragm had broken away and fouled the blading of the rotor. The set was put to work again without this diaphragm and without the blading of one wheel of the rotor, but the third and fourth diaphragms also were found to be in a precarious condition, and are being replaced with others of English make. The blading was found to be of an alloy containing an excessive proportion of nickel—over 31 per cent.—a material well known to be unfit for use, especially with superheated steam. But this was not the end of the trouble; at any load above 3,500 KW. the disks vibrated laterally so far that they fouled the diaphragms on both sides. These disks were extremely thin—thinner than in British turbines—and when the machine was standing open they could be seen to vibrate violently, in sympathy with the imperceptible vibration caused by other turbines, thus proving the presence of a high degree of resonance, a well known danger. Moreover, the rotor of the alternator was found to be permanently earthed, and as it could not be rewound owing to the extreme complexity of the winding, it had to be discarded and replaced by a spare rotor, which fortunately had been purchased. The engineer and manager of the company, Mr. F. W. Clements, states that the behaviour of the set has shown it to be very considerably inferior to most machines of British or American manufacture.

NEWPORT (MON.).—During the year 1915-16 a 3,000-KW. A.E.G. turbo-alternator, running at 3,000 R.P.M., broke down and was out of commission for five weeks.

SOUTH AFRICA.—The following notes on German electric power plant in South Africa are taken from a recent address on "The Power Supply of the Rand," by the President of the South African Institution of Engineers (Mr. Bernard Price), a full report of which has appeared in the *South African Mining Journal*:—

British engineers, the President said, are no less skilful than their German competitors, and, in his experience, the merits of German design have often been considerably overrated. It is not uncommon to meet with German plant in South Africa which betrays every evidence of scientific knowledge from a purely theoretical point of view, but it is hopeless when viewed from a practical standpoint. The winding of a large alternator, for example, is complicated enormously merely to gain some slight benefit in rating, but at the sacrifice of features which are infinitely more valuable to those

who will operate and maintain the finished machine. In this connection the following instances, taken from the experience of a large electric power supply company, were cited to show that although two leading German firms were somewhat ahead of British firms in developing electrical plant of the size and voltage required for large power schemes in South Africa, the German firms made many mistakes, and had still to acquire much experience at the expense of their customers:—

Six 4,000-K.V.A. alternators made by a German firm had to be entirely rewound, and seven 12,000-K.V.A. alternators (including a spare stator) had to be entirely rejointed. The smaller machines were originally wound for 10,000 volts, so as to avoid the use of step-up transformers, and the design of these high-tension windings was totally inadequate. Lightning made short work of them, but, in any event, their life could not have exceeded a few years. On the largest sets the joints between slot bars and end connections overheated very soon after the machines went into commission, and caused a long succession of serious and expensive breakdowns. The design of these joints had to be radically modified, involving a most tedious and costly programme of work.

Numbers of sub-station transformers of 1,000 K.V.A. and 500 K.V.A. capacity, made by the same firm, proved incapable of standing the stresses imposed at times of fault on consumers' circuits. The method of clamping the coils had to be entirely redesigned.

The high-tension switchgear for 40,000, 20,000, and 10,000 volts proved lamentably deficient when called upon to meet working conditions on a system of this size and type, and it would be difficult to exaggerate the seriousness of the consequences which ensued. No scheme in the world had had to face such serious switch trouble, and, when approached, the makers could suggest no better remedy than a duplication of all important switches at the expense of the power company and to the profit of the makers. Needless to say, this course was not pursued. The trouble had been almost entirely removed by the application of engineering commonsense to the experience gained in practice. It was quite clear that in those days this firm knew very little indeed about the design of high-tension switchgear for large systems. They were quite satisfied to proportion up the dimensions of a low-tension switch.

When asked to advise on the problem of lightning protection, experts (so-called) were sent out by the German firm to report, but, despite all their theoretical argument, nothing of practical value was produced. This problem, like many others which arise in commercial engineering, had to be solved by weighing up experience and avoiding fantastic proposals.

Although the turbines were a good job in many respects, heavy maintenance charges were incurred on account of defective blading. There was no doubt that the firm had but little knowledge respecting the materials best suited to stand the peculiar conditions to which turbine blades were subjected. At one time accumulation of these blading troubles very nearly involved curtailment of supply, but it became clear that some of the defects which were most pronounced originated from faulty design, and these had now been rendered less acute.

The steam pipes, valves, and lagging were a most shoddy job. The flanges on the steam pipes were expanded on without riveting, and a serious accident was but narrowly averted at one power station due to the expansion and consequent withdrawal of one of these flanges. It had been necessary to re-expand and rivet-on every flange of every steam pipe at two power stations, and the whole of the lagging, which had begun to break away before the pipes were dismantled, had to be scrapped and replaced by material of better quality.

The arrangement and design of three of the electrically-driven compressors at another power station was a disgrace, and involved excessive cost in upkeep. The arrangement of intercoolers and pipe-work rendered it necessary to dismantle the compressor itself before the intercoolers could be cleaned.

Seven 12,000-K.V.A. 3-phase transformers made by another German firm had to be entirely rewound. The original windings were deficient in insulation, and the surface of the copper conductors had been burned during the process.

The President of the Institution added that while he was quite ready to admit the merit of much of the German workmanship and design, and while he could not but admire the organising power displayed by German concerns, he did not think they had reason to be proud of the record of the plant they had installed in South Africa. It was quite certain that leading consulting engineers and manufacturers in the United Kingdom would have avoided many of the mistakes which South African power companies had had to correct.

INDIA.—Not long ago we published a description of the plant of the Tata Hydro-electric Power Supply Co., Ltd., Bombay, which included four 8,000-KW. alternators built by the Siemens-Schuckert Co. When these machines were being put into commission serious trouble was experienced, owing to the steel magnet rings of the rotors becoming loose on the spiders. Considerable delay in starting up resulted from the defective construction, in addition to much damage to the windings of one of the generators. Eventually the trouble was overcome by inserting a thin liner between the magnet ring and the spider, and shrinking the ring on afresh.

SOUTH WALES.—At Messrs. D. Davies & Sons' Ferndale Collieries, the blading was stripped from an A.E.G. turbo-compressor rated at 5,000 cu. ft. per min.

Since the outbreak of war, four 3,000-KW., 20,000-volt, 3-phase, 40-cycle A.E.G. transformers, with oil-cooled air blast, which had only been in service for a few years, have had to be rebuilt and rewound. Four other A.E.G. transformers, rated at 3,000 K.V.A., 20,000 volts, 40 cycles, 3-phase, with oil cooling by forced circulation through a cooler, though quite new, were found to be so badly designed that the purchasers decided to have them reconstructed and rewound before even putting them in service.

NORTH-EAST COAST.—That German plant installed in North-country stations has broken down appears to be widely known; we have not, however, been able to obtain particulars regarding these incidents. As regards cables, however, some information is available. The A.E.G. obtained a contract for a large quantity of 20,000-volt underground cable, which it duly supplied, but when the cables were laid the makers were unable to joint them properly. The joints were, in fact, made three times over without success, and eventually the purchasers' engineers had to take the work in hand and joint the cables, developing improved methods of jointing for the purpose.

METROPOLITAN DISTRICT RAILWAY.—Some 12 or 15 miles of high-pressure cable were supplied and laid by the A.E.G., but here again the makers were unable to make satisfactory joints, and in the end English jointers had to be employed for this purpose. A similar trouble occurred when Lahmeyer's (now A.E.G.) laid cables in Cardiff some nine years ago.

LONDON.—It is well known, though the facts have not been published, that a German company supplied cable and laid it through London from Charing Cross to Bow; the cable proved defective, and had to be entirely replaced.

EDINBURGH.—A cable supplied by a German company some years ago broke down, owing to the use of unsuitable materials in its construction.

KINGSTON-ON-THAMES.—Four years ago a number of Diesel engines, manufactured by the M.A.N., were installed at the generating station of the Kingston-on-Thames Corporation. Recently the air-compressor on one of the engines broke down and put the set out of commission. It will not be available again till February or March next, and in the meantime, owing to the necessity of using steam engines, the cost of production has seriously increased; a new crankshaft is required, the cost of which is estimated at £1,000.

TRADE WITH RUSSIA.

(*Concluded from page* 587).

"There are three things that will operate strongly in our favour. First, the discriminating duties that will undoubtedly be levied by Russia in favour of the Allies. I quite anticipate that these will be more favourable to the Allies than to the Neutrals, and, of course, very much more so than to the enemy nations. In the second place, there will be for some time a very strong prejudice against the enemy in favour of ourselves. This sentiment will be a very strong factor, but it will gradually weaken under the stress of competition, and unless it is cemented, will eventually die away altogether. In the third place, the competition of Germany and Austria will be still further lessened by their inability to give the long terms of credit, which has been one of the most formidable elements of competition in the past." However much the Government can do, and they can do a great deal, yet, after all, our business relations with Russia, and the success of our efforts, will depend more on individual initiative and enterprise. All that the Government can do will be of very little use to any manufacturer who does not make his own personal inquiries, and use his own efforts. "Who would be free, himself must strike the blow."

"There is a general feeling in this country that in order to do business with Russia we must slavishly follow German methods. It is thought that we must make inferior goods, take enormous risks, give long credits, adopt a spy system, in which the Germans are past masters, and generally do many things that are repugnant to the English idea of business ethics. After a very exhaustive inquiry, I am convinced that these opinions are to a very great extent wrong. We must in the first place approach Russia in a sympathetic manner, entering into her aims and aspirations, convincing her that we only want to do business on permanently and mutually advantageous conditions; that we want to help her develop her own industries, and to supply her with such goods as she cannot advantageously manufacture herself, at any rate for the present. There is a sufficient field on these lines to satisfy all legitimate aspirations. We must be prepared to meet Russian conditions to some extent; we must be ready to, at any rate, deliver goods to a Russian port, instead of f.o.b. England. We must print our catalogues in the Russian language, and give the equivalents of English weights, measures, and currency in Russian terms. To the manufacturer who insists that he only wants business with Russia on his own lines and his own terms, who insists upon quotations in sterling, and English weights, upon prices at factory, with cases and packing extra, with cash against documents in England, I say "Hands off! You will never do business with Russia, and it is better for you to spend your energies in other directions." To the manufacturer who

is willing to meet, even to a reasonable extent, the requirements of Russian trade, I say, that a safe and profitable trade can be done, on comparatively short terms of credit, if the most elementary precautions are taken in ascertaining the *bona-fides* of agents and purchasers.

"The question of credit has been the greatest stumbling block to trade between this country and Russia. During my six months' trip I gave this point closer investigation and more consideration than perhaps any other. It was always very grossly exaggerated; in many, if not most, cases a question of negligence in collecting, and in any event, is altogether changed by the war. Without wasting time in discussing the pre-war conditions, let me give my impression of the present situation. First of all, whatever element of competition there has been in the long credit given by Germany, she will not, for some time at any rate, be able to do so, even if she had the opportunity. It was only possible by the local German banks financing the manufacturers, and the local banks, in turn, getting their money through the Deutsche Bank, which discounted its bills on the London market. This, I hope, will not be possible again, and the Germans will want every penny they can get for their own purposes, without giving credit. Further, for more than two years the Russians have now been accustomed to pay in cash for all their purchases, not only in England and America, but also between one another. A prominent Moscow cotton manufacturer told me that after the war practically all business from his factory would be done on much shorter terms of credit than before, and that the precedent created now would make them only too glad to buy at three or four months' credit. The most effective contribution to shorten credit, however, lies in the abolition of vodka. I am thoroughly convinced from what I have seen and heard that this measure is producing, and will produce, the most marvellous change that Russia has seen for centuries, changes even greater than the influence of the war itself. It is not merely a question of roubles and kopecs, although this alone is enormous. The vastly increased savings in the banks only tell part of the tale; farms are being restocked with the money saved from vodka; peasants are demanding and getting more of the comforts and luxuries of life, and the productive capacity has been increased two or threefold. Money is, and will be, plentiful, and the necessity for long credit no longer exists, except in certain exceptional cases. Three, four, or possibly even in some cases six, months' credit will be required, if only from the fact that the distances are so great that it often takes several weeks before the receipt of the goods shipped. If possible, bills should be obtained for purchases. There is no cheque system in Russian as there is in this country; payments even for the largest amounts are usually made in cash, and the Russian waits for somebody to come and collect the money. I had some accounts to collect from 18 months to two years old. These were paid immediately I asked for them, with the statement that no one had previously asked for the money, or it would have been paid long ago. Firms having agents in Russia should insist upon their prompt collection of accounts, and refuse to pay commission until the cash has been received. If it is not considered desirable to trust the agent with the collections of moneys to be banked at once to the credit of the firm, then it is necessary that someone should go out once or twice a year, when, as a rule, he will have no difficulty in getting in the money due. A good plan would be for a number of firms to combine together, and appoint a responsible man entirely for the purpose of collecting accounts, and I have myself in contemplation the formation of such an organisation in connection with my own general bureau of information.

"The appointment of agents is one in which the greatest blunders have been made, and through which the greatest catastrophes have occurred. British manufacturers seem in many cases to have ignored the most elementary caution in the appointment of these agents. They send out their catalogues and trade terms to any Tom, Dick, or Harry that writes from Russia for them. This, in itself, compromises them at once, as the man goes round immediately, claiming to represent the firm, showing the letter he has received as his authority. With German goods out of the market, there are thousands of people in Russia who are looking out for British agencies, some of them with very high-sounding names. The majority of them are utterly irresponsible and very dangerous to do business with, while others, of course, are men and firms of the highest reputation and integrity. The utmost caution should be taken in appointing agents, or even in quoting agency terms. Another great mistake is to give the agency for the whole of Russia to one person, especially if it is for any definite period of time. It is only in very rare cases that any agent can begin to cover so vast a country, and a statement that travellers are sent over the country, or that there are correspondents in every centre, should be taken, as a rule, with a very considerable amount of salt. It is true that in some specific cases, such, for instance, as textile machinery, the ground can be covered fairly well from Moscow, and in dealing largely with the Government Petrograd would be the natural seat of the agent. But as a rule, for anything like general merchandise, there should be agents at both Petrograd and Moscow, at Kharkov or Ekaterinoslav, at one of the Black Sea ports, at Rostov-on-Don, in the Lower Caucasus, at Ekaterinburg, and in Siberia. Since a contract giving the agency for Russia, *ipso facto*, includes Siberia, this should be borne in mind. No agencies should be given for any period without some guarantee of sales, otherwise the firm may find that it is simply being nursed for the benefit of German competitors. Generally speaking, there are two classes of agents; one is the firm with ample financial resources of its own, which buys and pays for the goods in its own name, selling at its own prices, and, of course, reserving the sale of the goods in Russia or the distribution allotted to it. The other is the purely commission agent who sells goods in the name of the firm, which are invoiced direct to the customer. In this case, the financial standing of the agent is not of so much question as his integrity and ability, for these two elements involve risk and bad debts. An agent selling on commission is liable not to take as much caution in the financial responsibility of the purchaser as he should do, unless he is made responsible for at any rate part of the losses that may be sustained. It should, moreover, be a condition that commissions are only paid on accounts for which payments have been received. Even in this case, I think it extremely desirable that a representative of the firm should go out occasionally, getting into personal touch with the customers, looking after the overdue accounts, and generally seeing if he is getting the best service from the agent. Another excellent plan is to get a bright young fellow trained for the purpose, who has at least an elementary knowledge of Russian, and send him to Russia with samples, prices, &c. This plan has been worked successfully by comparatively small manufacturers of saddlery and other goods. It is comparatively inexpensive, and a bright man can soon, with a little initiative help from the Consuls, know what he is doing.

"Still another plan is to send out a traveller, or travellers, once or twice a year; and where the business warrants it this is, perhaps, the best plan for many trades. He should, of course, have a very fair knowledge of Russian, and should be a sympathetic rather than a clever man. In other lines of business, local factories can be set up with decided advantage, as naturally, in this way, the heavy Customs duties are avoided. Where possible it is, however, better that these factories should be devoted to the manufacture of the heavier parts, while the more intricate parts are made in this country, and sent out to be assembled in Russia. The Russian Customs duties are based almost entirely upon weight, and the heavy casting would pay as much per lb. as the smallest part with a hundred times as much value. The whole question of agencies and selling generally is, however, one that has to be decided by individual circumstances, and there is no golden rule to be adopted. It is one of the most essential of the preliminary inquiries to be made, to consider the best way in which any particular business can get a foothold in the Russian market, and this refers also to the distribution of territory and the methods to be employed."

Mr. Beable referred lastly to the needs for improving our Consular system in Russia. "We want more and better paid Consuls, we want men of commercial experience, we want larger staffs in our chief Consulates, and we want them more closely allied to and connected with the Board of Trade, rather than the Foreign Office. We want a Commercial Attaché or Commissioner independent of the Embassy, and with an office of his own. Even the Canadian Government have such an office and representative at Petrograd, whose sole business is to investigate and report upon trade possibilities, responsible directly to his own Government.

"There are possibilities of business in Russia beyond the dreams of avarice, and we can get our share if we approach the question in the right spirit, and if we adopt the right methods."

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Perfecta Boiler Circulator.

The Perfecta Boiler Circulator, Ltd., of 39, Victoria Street, S.W., in a recent pamphlet describes its circulating device as fitted to an ordinary Lancashire boiler. This apparatus consists of a hood or covering over the crowns of the twin furnaces, which, when steam is generated beneath it, creates a flow of water towards the back of the boiler over the flues, the water then passing downwards and returning along the bottom of the boiler to the furnaces. Such a circulation obviously tends to a more uniform water and boiler temperature; to the deposit of any sediment near the blow-off cock; the elimination of priming over the grates and reduction of scale. The fixing of the apparatus does not necessitate the drilling of any holes in the boiler or interference with existing fittings, and it can be dismantled in a few minutes. It is claimed that from 12 per cent. to 15 per cent. increased steam with a minimum of saturation can be obtained, and that from 6 per cent. to 8 per cent. of fuel is saved. The makers are prepared to prove the efficiency of their apparatus by a reasonable trial.

Simplex Universal Girder Clamps.

One of the greatest difficulties in present wiring installation work is the trouble experienced in negotiating steel girders.

The Engineering Standards Committee has done excellent work by choosing certain girders for general use, but the number is still very great. There are section rolled girders, riveted girders, also channels, angles and Tee-sections in great variety.

D

A large number of girder clips are on the market but nearly all of them are made for a particular section of girder and even when a certain amount of adjustment is embodied in the design it is only within small limits that it can be used.

The Simplex clip (supplied by Messrs. Simplex Conduits, Ltd., of Garrison Lane, Birmingham) consists of a pair of clamps which fasten on to the edges of the girder and hold a wood piece on to

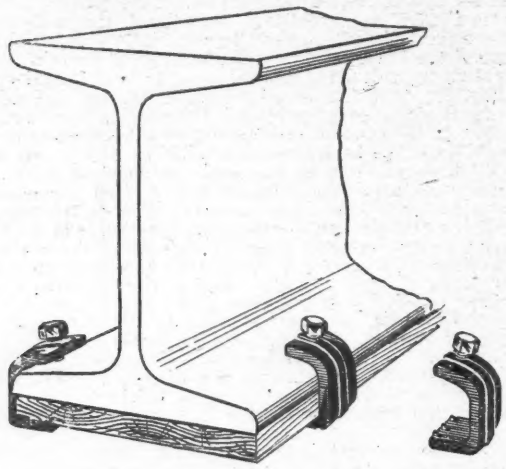


Fig. 1.—Simplex Girder Clamps.

which a saddle for the conduit, junction box or other accessory, can be fixed by an ordinary wood screw.

The clamps are made of tough malleable iron in two sizes at present, and are provided with a set screw for drawing the wood tight up to the under side of the girder, two or three sharp points being arranged to ensure the wood being securely held.

For angles or odd sections the batten can be placed lengthwise and two girder clamps spaced along the free edges to securely hold it in position ready for the conduit erector.

Loop-in Dividing Box and Push-Button Contact Maker Combination.

In some places—for instance, on boiler-house conveyor plant—it is required to stop the machinery, in the event of an emergency, from several positions. To effect this it is necessary to install a

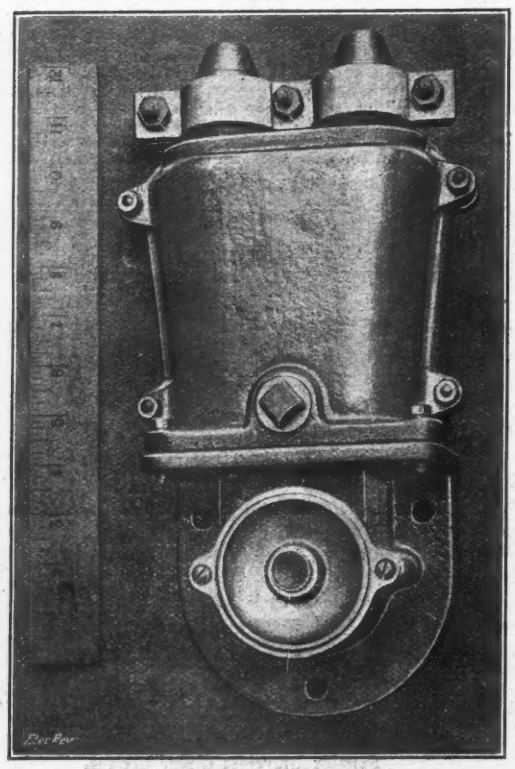


Fig. 2.—Reyrolle Dividing Box and Contact Maker.

cable extending from the main switch panel to the several points of control, and at these points to attach to the cable, contact makers so connected that the operation of pressing the button will instantaneously release the switch controlling the motor circuits.

For such work a simple combination of cable dividing box and push-button switch, made by Messrs. A. Reyrolle & Co., Ltd., of Hebburn, is illustrated in fig. 2.

The dividing box provides for looping-in an armoured two-core cable, and for joining the terminals of the press-button contact maker to the respective cores. The whole is of armoured construction, strongly made and capable of withstanding rough usage.

The Prestwich Fluid Gauge.

An ingenious device for gauging articles in course of manufacture has been patented by Messrs. J. A. Prestwich & Co., of Northumberland Park, Tottenham, London, N., and has been used with great satisfaction in their own works for three years on extremely accurate work. It is not subject to wear, and requires no manual skill in use.

It consists of a fluid-containing chamber A (fig. 3), having a flexible diaphragm B, a glass tube C of fine bore, which is connected with the chamber A, means for indicating the dimensions of the piece, and means for correcting for variations of temperature. The diaphragm B is provided with a hardened-steel anvil D. The article to be measured or gauged is passed between this anvil D and the fixed anvil E. Any pressure on the anvil D causes the fluid to rise in the glass tube C.

The chamber A is provided with a thread and micrometer index and pointer on the upper surface to indicate thousandths of an inch (or hundredths of a millimetre). The carrier F is provided

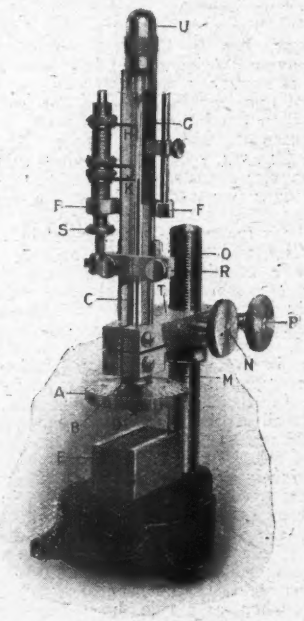


Fig. 3.—Prestwich Fluid Gauge.

with a scale G and three adjustable pointers H, J, K, the scale being divided to indicate ten-thousandths of an inch (or one-thousandths of a millimetre). The two top pointers H, J, indicate the tolerance limits it is desired to work to. The carrier F is adjusted by the thumb-nut S to keep the bottom pointer K level with the normal level of the fluid in the glass tube C, and thus compensates for variations of temperature.

The instrument is roughly set by rack M and pinion N on the pillar O to suit the article; the clamping screw P is then tightened up, and the final adjustment is made by the micrometer adjustment to a standard gauge or piece of known dimensions.

A displacement of the diaphragm B causes a displacement of the level of the fluid in the tube C relative to their respective areas. Any variation in the size of pieces passed under the gauge is indicated by the difference in the heights to which the liquid rises in the glass tube.

Glass tubes of different bores are used to magnify 500 to 1,200 times, according to the accuracy required.

By using suitable anvils or work blocks, a very large variety of work can be gauged, and besides extreme accuracy, which is always retained, the gauge has the advantage of saving half to three-quarters of the time required for gauging with the micrometer.

The Effect of Temperature upon the Alkaline Storage Battery.—Tests made by Mr. L. C. Turnock on the Edison battery show that the temperature at which the battery is used has an appreciable effect on its performance and durability. At low temperatures the available capacity is decreased; the current efficiency increases with rise of temperature up to 50° C., above which it falls off rapidly. The best electrical efficiency is obtained by charging at a low temperature and discharging at a higher temperature.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Wayleaves.

We read with much interest the article on "Wayleaves" in your issue of November 10th, and had hoped to see further reference last week. The article applies, of course, equally to telephone work as to power supply; but we note that the writer is "interested."

So, too, we think is the writer of this letter, with a decided leaning one way, or ought to so lean, after nearly 40 years in the trade. At the same time, circumstances alter cases; and ours is, we think, an example.

At considerable outlay, our property has been acquired, the intention being to build on and utilise the surrounding vacant ground, which is pretty considerable; in fact, we are *bound* to build under the terms of the lease. Originally the place was a large L.C.C. school, the vacant grounds around forming a playground for the children; but we are transforming the premises, &c., into a factory—incidentally to capture a special German trade.

Now, as a children's playground, there was no objection to some 64 overhead wires, even though they occupy a space some 6 ft. × 6 ft., about 25 ft. above the ground; but we want to develop the site (in fact, have no option), and these wires are in our way.

After months of remonstration the super-intelligent P.O. officials write that they are entitled by Act of Parliament to have them there, which is equivalent to saying that the tenancy was created by the vendors (represented by a well-known and highly respectable firm of City solicitors) by misrepresentation, as, according to these same super-intelligent P.O. officials, we are debarred from building, and are therefore bound to commit a breach of the terms of our lease.

Anyway, when some 64 telephone subscribers in this district find themselves (as they certainly will) all talking to one another at once, do you think we are to blame? We should much like to hear your views.

The Stanneries Metal Works.
H.S.

London, S.E., *November 21st*, 1916.

[Our sympathies are with our correspondents. We can hardly doubt that the law is on their side—either against the Post Office, which cannot possibly claim free wayleaves in perpetuity over private property, or if this incredible condition were found to obtain, against the lessors of the site, who cannot maintain the terms of the lease.—EDS. ELEC. REV.]

Final-Grade Classes in "Electrical Installation" Work.

Mr. A. P. Trotter says he quite agrees with the Editorial note to our letter (issue of 17th inst.); and he goes on to say that technical colleges should not concern themselves with handicrafts!

In your last issue we commented on your Editorial note, and pointed out that what some people term handicrafts *are*, as a matter of fact, dealt with in the London Polytechnics.

If they were not, there are very few other places where instruction would be obtainable, so we are very sorry to see that Mr. Trotter opines that technical colleges should leave "handicrafts" alone.

If we may say so, it is very easy to talk glibly about handicrafts and trade schools; but, after all, what is a handicraft, and how many trade schools worthy the name are there in London?

Such things as fretwork and clay-modelling are pure handicrafts, carpentry and joinery are partly so; but plumbing is half handicraft and half a technical subject; while electrical installation work is certainly more of a technical subject than a handicraft.

Mr. Trotter will, perhaps, allow us to point out that he does not say whether we are to infer, from the remarks of his we quoted in our first letter, that final-grade classes are, so far as London is concerned, only held at the two London Institutions he mentioned.

We gather that Mr. Trotter is fully alive to the importance of electrical installation work; but we think he has been misled if he really thinks that Principals of Polytechnics, &c., are enthusiastic about doing justice to the subject.

If Mr. Trotter desires to see the matter from the point of view of the public, we would respectfully suggest that he should first read carefully the City Guilds syllabus of the subject, think of the hundreds of thousands of individuals that would welcome tuition therein, and visualise the treatment and equipment necessary. If after doing this he will take the trouble to walk into the nearest Technical Institute or Polytechnic, and ask to see the manner in which the subject is dealt with, the chances are that he will be considerably disappointed at what he finds.

In some places he will possibly find that, though electrical engineering is taught, "wiring work," to give it its bad old name, has been forgotten. At some big Institutions he will find that seekers after knowledge are recommended to attend at some other Institution, perhaps two or three miles away. And we have heard of instances where the classes have been temporarily dropped because of the war, the authorities presumably fearing that they might have to pay the teacher his miserable pittance for teaching only a few students.

Speaking of teachers, reminds us of the treatment generally meted out to them; but that is another story.

We are sorry Mr. Trotter still thinks the demand should precede the supply, as this rather plays into the hands of those who do not encourage the supply. The supply of teaching facilities in a subject like this cannot be dealt with like an order for goods.

A. P. Lundberg & Sons.

London, N., *November 27th*, 1916.

"Summation Watt" Capacity of Field Rheostats.

Referring to Dr. Garrard's letter of the 20th inst., I would point out that the various formulæ advocated by me are in practical everyday use.

For a current range of, say, 1·0 to 1·5, or less, both his and my formula closely agree with the theoretical basis; however, if a designer has available a sufficient range of ohmic values and ampere capacity in his choice of resisters, then obviously he can in practice closely approach the theoretical size of rheostat required for any current variation. If the designer is limited to a small range of resistance, then for such wide current variation the maximum radiation possible of the resisters in circuit cannot be made use of throughout the whole range. That is to say, in this respect it is inefficient, although it is the best that the designer can do under the circumstances, and, of course, is not detrimental in any respect except that the bulk would be greater than another, having a wider choice of resister values. This matter of resisters available is the whole crux of the question, and as only the individual designers know of their limitations in this respect, I submit that my formula, based on fundamental principles, is the correct method of determining the size of rheostat, the designer applying a correction factor, if necessary, to suit individual rheostats, as each manufacturer has a large number of sizes and various types of resisters.

This question of "summation watts" is only the preliminary factor that enters into the design.

With reference to Dr. Garrard's remarks on potentiometer rheostats, the following case may be interesting:—A potentiometer rheostat was required for a 10-ampere, 20-volt battery-charging generator having a hot field resistance of 3,200 ohms, separately excited from a 250-volt supply. Obviously 2 to 4 ohms per volt would not be too high, and alternatively two to four times the field resistance would entail either an undesirable very fine gauge wire, or a much larger rheostat than that supplied.

The moral of all this is (to quote the words of Mr. T. Carter), "the use of a formula without care and intelligence is certain to lead, sooner or later, to disaster; a formula is a good angel if a servant, but if it becomes master, it is more subtle in temptation than Satanus himself."

L. Boothman.

Stretford, *November 27th*, 1916.

LEGAL.

JAEGER BROS. *v.* GREAVES.

IN the Lord Mayor's Court, last week, before the Recorder (Sir Forrest Fulton, K.C.), and a jury, a claim was made by plaintiffs, a German firm of electrical cable and fittings merchants, Finsbury, by Maurice Jenks, chartered accountant, suing under the authority of the Board of Trade as controller of the firm, against Mr. T. W. Greaves, of Barnes, to recover £201 11s. 8d., the price of electrical goods supplied. The defendant set up an arrangement made between the plaintiffs' manager and himself in August, 1914, by which he was to have goods of the value of £200 in satisfaction of an agreement which he had with the plaintiffs, whereby he was to serve them as sales manager for a period of one year, terminating in June, 1915. Alternatively, he said, if that was not the bargain, he claimed damages for wrongful dismissal.

Mr. Moreton Smith was counsel for the plaintiffs and Mr. Louis Green for the defendant.

COUNSEL, for the plaintiffs, said that the firm of Jaeger Bros. was owned by Germans resident abroad and managed in this country by a German. They did business in the sale of electrical cables and other electrical fittings. The defendant was employed as sales manager in that business. Upon the outbreak of war with Germany the business was closed down. Subsequently the Treasury sanctioned the business being carried on, the German manager being interned. At the time the business was closed down the goods, the price of which was now being sued for, were sold by the German manager of Jaeger Bros. to the defendant, in order that he should start in business, and the terms were that he should have the goods at cost price, paying 50 per cent. down and 50 per cent. within three months. Defendant made his selection of goods, and after getting delivery of them declined to pay, contending that having an agreement for service with the plaintiff firm he was entitled to compensation. The German manager by whom the arrangement was made with the defendant requested the return of the goods if the defendant was not satisfied with the arrangement. The defendant, however, kept the goods. The defendant had started business in Oxford Street as the Wholesale Electric Supplies Co., which business had since been turned into a limited company. Mr. Maurice Jenks was appointed by the Board of Trade first as inspector and supervisor, and subsequently controller of the German business. It was his duty as a public official to collect the assets of the firm, and in carrying out his official duties he had brought that action. The defendant's claim to the goods as a set-off for compensation for breach of agreement was repudiated.

Mr. H. G. M. Osborn, formerly provincial representative of Jaeger Bros., gave evidence, and said that upon the outbreak of war the business was closed down, the staff receiving a week's notice terminating their engagements. On September 18th, 1914, he (witness) was appointed manager of the firm by the German manager, who was eventually interned. On September 23rd the business was allowed to be carried on by the Treasury. In February, 1915, Mr. Maurice Jenks, chartered accountant, was appointed by the Treasury, inspector, on March 2nd supervisor, and on March 9th, 1916, controller of the business. In August, 1914, upon instructions from the German manager, an invoice was made out to the defendant for £225 6s. 8d., and of that sum £25 had been paid.

Mr. T. W. Greaves said he had been in the electrical business for 23 years, and in March, 1913, he entered the service of Jaeger Bros.; the agreement was afterwards renewed. Upon the outbreak of war the manager said he came to the conclusion it was best to close the business, and he told witness he was entitled to some compensation under his agreement. He asked for a cash payment, but as that could not be obtained, it was afterwards arranged that he should be allowed £200 in goods at the firm's lowest selling price in settlement of his claim under his agreement. He was to go on August 15th. The goods he selected came to £225, and the £25 had been settled. Afterwards he refused to acknowledge the receipt of, or return, the goods as requested by the German manager, unless he was given some form of security for any claim he had against the firm in respect of his agreement. He had never agreed with Jaeger Bros. to take £150 worth of goods at cost price and discharge them from all liability in respect of their contract. The goods were not invoiced at cost price, but at lowest selling price.

The jury found a verdict for the plaintiffs.

The Recorder directed the jury to return a verdict for the plaintiffs on the counterclaim, holding that the war put an end to the defendant's contract of service, and so far as the action for wrongful dismissal was concerned, there could be no claim for damages. Judgment was accordingly entered for the plaintiffs on the claim and counterclaim. A stay of execution for seven days was granted.

Pearmain *v.* Johnson & Phillips, Ltd.

In the City of London Court, on November 24th, before his Honour Judge Rentoul, K.C., this case was mentioned. The widow and mother of the late Walter Pearmain, electrical engineer, Acton, claimed £300 against defendants, electrical engineers, Willesden Lane, Acton, as compensation for the death of their husband and son respectively.

Mr. Newman, counsel for the applicants, said that the widow was married on September 21st. The husband was killed on October 14th by electric shock in an accident at Messrs. Johnson & Phillips's works. The firm, recognising their liability, paid £300 into Court. The widow and mother of the deceased had come to an arrangement whereby the widow was to have £200 and the mother £100. Previous to the marriage the mother lived with her two sons, of whom the deceased was one. Both were electricians. The two sons allowed the mother 10s. per week each. On the marriage that payment by the deceased was still to be paid to her, and intended to be paid. The mother was living with the other son, who was married. For the last five years the mother had had £100 invested, so she knew how to take care of money. The widow was formerly a nurse. Her parents had a small boarding house at Eastbourne. Both the applicants had decided to start a small boarding house at Eastbourne, and they would like the whole £300 paid out to them. The parties were in a different condition to the average workman's relatives.

Judge Rentoul granted the application, but warned the applicants to be very cautious in starting any business during the present circumstances, having regard to the uncertainties of success.

Mining Electrician's Application.

Harry Young (Hurlford), a mining electrical engineer, applied for a clearance certificate from Ardeer Co., at a Munitions Tribunal at Kilmarnock.

Mr. Harry Fletcher, secretary of the Electrical Trades Union, Stevenston Branch, appeared for the applicant, and pointed out that to obtain munitions they must have coal, and to get the coal they must have at the pit a fully qualified mining electrical engineer, which applicant was. At Nobel's he was only employed as a general electrician. He had a definite offer as a mining electrician, and then he would be nearer home. He stayed in Hurlford, and each morning at 5.10 had to walk to Kilmarnock to get the train there for Ardeer. If he got the other job he would only have a distance of 5 miles altogether.

The Ardeer representative said they had a special train from Kilmarnock. They were so placed that they could not get sufficient men in the surrounding district.

The application was granted.

Medley *v.* Dingwall.

In the Shoreditch County Court, on November 25th, before his Honour Judge Cluer, the hearing was resumed and concluded of an action in which Mr. C. P. Medley, the London Hoist and Machinery Co., of 103, Worship Street, E.C., electrical engineers, sued Mr. T. G. Dingwall, of 53A, City Road, E.C., packing-case makers and shippers, to recover £40 3s. 6d., the balance of an account of £150 3s. 6d., for supplying and fitting a second-hand electric gear to a lift, together with accessories.

Mr. Foster appeared for the plaintiff, and Mr. D. Rowland Thomas was counsel for the defence.

Evidence was given for the plaintiffs that they entered into the contract for the fitting up of an electric lift, which they carried out. The motor, which was fixed on a cast-iron bed, was complained of, so they put in another, but, to save time, they banked it up with blocks of wood on the top of the cast-iron bed. They left it in perfect running order.

Mr. J. Shearman Wilkerson, foreman bale packer, called for the defence, said that after the new motor was installed the lift worked so badly that he went and implored the plaintiffs to come and put things right, but things got no better. One fault was that the sheave did not grip, and left the wheel running, and the defects were still present. It was fitted to take 10 cwt., but at times would not take 5 cwt. If the rope was pulled for it to go up, it would, at times, go down, and it became dangerous to work it, as they never knew when it might deposit the operator and the load in the well of the lift. He had told the operator to put less weight on, which meant that two journeys had to be taken for one.

Mr. Foster: Do you know it is not possible to reverse without reversing the armature of the connection?

Witness: I have seen the rope pulled for it to go up, and it has gone down.

Mr. Dingwall gave evidence, and said that a few hours after the new motor was put in he had complaints. The controller was the cause of most of the trouble, as it worked so erratically that when pulled one way, it went the other. As an electric lift it was quite a failure.

Four experts, Mr. Ernest Ellison, A.M.I.M.E., Mr. Bourne, Mr. Gallon, and Mr. Percy H. Arber, A.M.I.M.E., were called, all of whom said the lift would not do its work properly as it was. It stopped, reversed, would not start with its full load at times, and so on.

Mr. Bourne said that to put it in proper working order as an electric lift of good quality would cost £200.

A witness having said it was dangerous to life, Judge Cluer said it was lucky for them they had not lost a lot of lives, he supposed, and the witness agreed.

Judge Cluer said he went to the factory; he paid a special visit to view the electric lift; it did not reverse while he was there. He thought the fault lay in the human operator being incompetent, as the plaintiffs could work it quite well. The motor had been put on wood blocks instead of cast-iron, which might cause vibration, so he would allow £2 for that, and give judgment for the plaintiffs for £38 3s. 6d. Leave to appeal was granted, on the amount of the claim being paid into Court.

WAR ITEMS.

Black Lists.—The "London Gazette" for November 24th contains a further list of persons or bodies with whom trading is prohibited in Brazil, Denmark, Greece, Netherlands, Norway, Spain, Sweden, and other countries.

Lord Balfour's Committee.—According to a statement made in the House of Commons last week, the interim report of Lord Balfour's Committee on the resolutions of the Paris Economic Conference has been received.

German Electric Lamps for Italy?—An Exchange dispatch to the *Westminster Gazette* says it is stated in the Rome Press that half a million German electric lamps have recently arrived at a city in Northern Italy.

Sales of Enemy Interests.—The "Times" states that Messrs. Fuller, Horsey, Sons & Cassell have been instructed by the Board of Trade to realise the assets of the Bosch Magneto Co., Ltd., and the London Emery Works, Ltd.

To be Wound Up.—The Board of Trade has ordered the following company to be wound up:—

Sanitas Electrical Co., Ltd., 61, New Cavendish Street, London, W., dealers in medical electrical apparatus. Controller: James Fraser, 31, Copthall Avenue, E.C.

Women-Workers.—We read in the "Times" that women are to be employed as electric tram drivers in Vienna. More than 5,000 women are already acting as tram conductors there. Our contemporary also states that Saxony has just permitted the employment of women as stokers for steam engines and boilers.

Export Prohibitions.—A Supplement to the "Board of Trade Journal" of November 23rd contains complete lists of articles which, according to the latest information received by the Board of Trade, are prohibited to be exported from Denmark, France (including Algeria), Greece, Italy, Japan, and the Netherlands. This Supplement also contains the list of articles (complete to date) which are prohibited to be exported from the United Kingdom.

War Metals.—The Minister of Munitions has appointed a Committee, under the chairmanship of Mr. C. W. Fielding, to advise him upon the steps which can be taken to secure the most economical use of the metals required in the manufacture of munitions of war. The *Times* states that Mr. Fielding has been chairman of the Rio Tinto Co. for the past 12 years.

Austrian Copper Shortage.—Having requisitioned the church bells throughout the country and stripped off the copper from the roofs of churches and public buildings, the Austrian Ministry of National Defence has now announced the confiscation of the copper on private buildings.—*Times.*

Air Raids and Electric Flashing.—Major-General Sir Francis Lloyd states that from observation made, it is interesting to note that sparking from electric trains and trams tends rather to confuse than to assist hostile aircraft in finding their way over London.

Glasgow War Bonus.—At a meeting of the Glasgow Electricity Committee it was agreed to recommend (1) that all meter inspectors and clerks employed in the electricity department, whose salaries are £65 and do not exceed £250 per annum, be granted a war bonus at the rate of 4s. per week; and (2) (*a*) that the female meter inspectors and female clerks, and (*b*) junior male clerks, whose salaries are under £65 per annum, be granted a war bonus of 2s. per week.

Entertaining Wounded Soldiers.—The wholesale and retail electrical trades of Bristol on Thursday, last week, gave a very enjoyable entertainment to the convalescent soldiers who are recovering from their wounds in some of the hospitals of Bristol. Some 320 disabled warriors accepted the invitation to the Art Gallery (kindly lent for the occasion by the Bristol Corporation, and the musical programme went with a good swing, the applause which greeted the various items testifying to the appreciation which was felt. Refreshments were provided, and the arrangements for the comforts of the men reflect great credit on the committee, who were untiring in their energies. Mr. A. H. Dowson (chairman), in a few well-chosen words, welcomed the "boys," and said it was only a very small way of showing how they all appreciated what they had given for those at home. The National Anthem concluded a very enjoyable evening. The committee, who in conjunction with the Inquiry Bureau had charge of the arrangements, were representatives from the Crypto Electrical Co., Veritys, Ltd., the Ediswan Co., the General Electric Co., Ltd., Siemens Bros., and several retail firms.

An Australian Law Suit.—The "Melbourne Age" of October 17th contains a report of the case Welsbach Light Co. of Australasia, Ltd., *v.* the Commonwealth of Australia. Plaintiffs' case was that it was a company, incorporated under the law of Great Britain, and was a seller of incandescent mantles, and sold such goods in Australia. An injunction was claimed restraining the Commonwealth Attorney-General from taking further action on a notice in the *Government Gazette* that the company was managed or controlled mainly for the benefit of persons of enemy nationality, and £65,000 damages were asked for.

For the defence, a demurrer was pleaded on behalf of the Commonwealth, that the statement of claim was bad in substance and not sufficient in law for the plaintiff company to maintain the action.

The Lord Chief Justice, in delivering his judgment, said that the statement of claim disclosed no cause of action, and there must be judgment for the defendant. Justices Barton, Isaacs, Duffy, and Rich agreed. Mr. Justice Higgins was not prepared to dissent from the views of his colleagues, though he had doubt. Mr. Justice Powers disagreed with the view of the majority of the Court. The demurrer, on a majority judgment of the Court, was allowed, and judgment was entered for the defendant.

The Use of Electric Torchlights.—In Dumbarton Sheriff Court last week, according to the *Glasgow Herald*, a number of prosecutions were made against young men and girls for having, during the hours in which lighting is restricted in the streets of Dumbarton, displayed a light by means of an electric torch, which might act as a signal, guide, or landmark. George Connor, caulker, Dumbarton, pleaded guilty, and it was stated by Mr. H. L. Yeudall, Procurator-Fiscal, that in the opinion of the authorities this torchlight business had become a regular danger. In this case, besides being a real danger, it was a real nuisance. Sheriff Macdiarmid said that he thought it would be obvious that the restrictions and regulations would not have been made regarding lighting in houses if accused and his companions were entitled to walk about the street flashing torchlights in the sky and about the streets. It was a practice which must be stopped. A penalty of 60s., with the alternative of 10 days' imprisonment, was imposed. Penalties of 30s. or 10 days' imprisonment were imposed on William Kennedy, David Cochrane, Joseph Quinney, John Hendry, Catherine Drysdale, and Jessie Bonnan, all of Dumbarton. His Lordship said it must be understood that while a shaded light or faint light, such as was used on moving vehicles, if carefully used would not be interfered with, nothing in the nature of a bright light would be allowed.

Exemption Applications.—At the Wigan Tribunal, application for exemption was made on behalf of an electrical engineer employed at a local picture palace. Exemption was granted on the understanding that applicant went to work in a coal mine.

At the Bedworth Tribunal, application was made for three men on the Tehidy estate, including an electrical engineer (aged 41, married), in charge of the electrical plant, water supply, &c. The electrical engineer was the only man left with the whole of the plant, &c., whereas there were previously two. Mr. Shopland said they did not want the man so much as a soldier as a skilled mechanic. The Chairman: The farms cannot do without water. The engineer was exempted to February 1st.

At Southwark, Messrs. H. Dunn & Son, electrical and mechanical engineers, of Newington Causeway, S.E., applied for the exemption of an electrical fitter, 25 years of age, and an armature winder, 29 years of age, both passed for general service. It was stated that the firm was exclusively engaged on the repairs and oversight of the electrical plant in a munition factory, where over 3,000 workpeople were employed on important work. They were also making special machinery for this firm. Mr. T. Haynes, J.P.: The difficulty is that they are both young men fit for general service. Mr. Dunn said they could not get old men for electrical work. They had advertised extensively in the technical papers, but got no replies. He read a letter from the Auxiliary Army Ordnance Depôt stating that the men were indispensable, and could not be spared. The fitter was placed in a certified occupation, whilst two months' exemption was granted the armature winder.

At Weston-super-Mare, the Electrical Supply Co., Ltd., appealed for P. W. Paull (27), cable jointer, originally medically rejected, and now passed in Class C 2. He is the only jointer on the staff, and cannot be replaced. The Military Representative assented, and conditional exemption was allowed. The company also appealed for F. F. Spearing (38), foreman electrician of the installation department, classed in C 3, after being rejected under the Derby scheme. The Tribunal allowed conditional exemption, with the assent of the Military.

Evesham Tribunal has granted final exemption to March 31st, with the Volunteer condition, to A. J. Howard (28), in sole charge of the electrical works of the Evesham Motor Engineering Co.

At Chatham, the Tramway Co. appealed for four of the staff, and, on their behalf, Mr. F. F. Smith said that some time ago arrangements were made by which the working staff was reduced to an absolute minimum. Captain Reid suggested that if the four men were fit for service they should be relieved if suitable substitutes were found by the Military authorities. Mr. Smith said that Mr. Jensen, the manager, would be quite agreeable to this, but he pointed out that 12 men who were medically unfit for military service had been tried, and they had to give up the work. It was arranged that the four men and others on the staff should be released when proper substitutes were found and given a trial.

Rochdale Tribunal has granted conditional exemption to Edmund Holden (31), motorman in the service of the Corporation tramways department.

The Tribunal at Castleton (Yorks.) has granted conditional exemption to Mr. J. W. Etherington (36), electric light bulb mould manufacturer, who is engaged on Government work, and is passed for general service.

At Weymouth, a certificate of conditional exemption has been granted to Mr. T. H. Escott (28), electrician and manager for Messrs. Brooking & Co.

Before the Northants Appeal Court, Major J. C. Lewis, of Derncote Hall, applied for extended exemption for Duncan Cameron (31), attendant to the electric light plant at the Hall. In reply to a question, he said he thought that a wounded soldier would not be competent to do the work. A final two months were allowed.

At Reigate, on November 21st, it was reported that the Surrey Appeal Court had reviewed the case of C. Morgan (29), shift engineer at the Corporation electricity works, and had, on the appeal of the Military, made exemption until January 1st final.

At Dover, on November 22nd, the Military applied for withdrawal of conditional exemption allowed to G. Hopkins (32), coal and ash trimmer at the Corporation electricity works, and recommended a month's exemption only. Mr. Vosper said the man was in a certified occupation and, irrespective of age, was exempted. The Mayor suggested that the man's services should be retained until a substitute could be found by the Military, and this was adopted. Mr. Woodman, for the electricity department, pointed out that the trouble was to get the substitutes to stay. He had had seven applications from men of between 50 and 60 years of age, but the job could only be carried on by a tough man, as he had to trim over 10 tons of coal and seven tons of ashes seven days per week on an eight-hour day.

At Romford, seven tramcar drivers, whose ages ranged from 31 to 36, were appealed for by Ilford U.D.C. The Clerk to the Council said that the staff had been considerably reduced. Mr. L. Harvey, tramways manager, said that it was impossible to run the present service with a smaller staff. Captain Howard suggested that women should be trained as drivers, and that women should take the place of conductors, but Mr. Harvey replied that the Commissioner of Police would not license women drivers. The Chairman said that the Tribunal was satisfied that some reduction could be made in the present staff; the public might suffer some inconvenience, but it would not be substantial. Two of the men would be allowed two months, and in the case of the others the appeals would be reviewed at the end of the same period.

Before the Stratford-on-Avon Rural Tribunal, Lieutenant Crosland, of Ullenhall, asked for leave to appeal for his elec-

trician, aged 28, he having failed to get a substitute. The Tribunal refused leave, considering that Lieutenant Crosland had had time to make arrangements.

At Eastbourne, an appeal was made by Mr. J. H. Batho, of Alfriston, for the retention of A. N. Gander (29), electrician, and exemption to December 31st was granted.

At Strood (Kent), on November 22nd, Messrs. Martin, Earl and Co. appealed for S. Richardson (27), electric machine attendant, and conditional exemption was allowed.

At the Leeds Appeal Court, an electrical engineer, in applying for an employé (married), stated that out of 20 men 11 had joined and four were on munitions. Temporary exemption was given to January 31st.

At Buxton, an appellant, aged 35, stated that he was the only practical electrical engineer in the town employing labour, and if he went his business would stop. Conditional exemption was granted.

At Douglas (Isle of Man), on November 15th, exemption was claimed for W. White (35), electrician, by Mr. Fargher, and exemption until February 12th was conceded.

At Douglas (Isle of Man), on November 15th, exemption recently granted until their apprenticeship was finished to B. A. Robinson (18) and W. A. Cowen (18), electrical engineering pupils with the Manx Electric Railway Co., was appealed against. The manager of the company, Mr. Edmondson, said they did not wish to keep the lads for the company's sake, but thought it would be better for the country if they were allowed to finish their time, and then join. Robinson was directed to join when called up, and Cowen, passed in Class C 2, was granted time to complete his apprenticeship.

Kidderminster Tribunal has given three months' exemption to C. J. Middleton (36), electrical engineer, engaged at the Opera House.

At Preston Tribunal, application was made for 10 Corporation tramcar drivers. Mr. J. F. Simpson (tramway manager) said he understood the Military were prepared to substitute these men, and all he asked was for exemption until the substitutes were forthcoming. If the men were taken at once it would mean stopping nine cars. They could not get men to take their places. He had an understanding with the Labour Exchange to send him three men a week to train as drivers, but during the past three months they had sent him only one man. The Military Representative accepted the condition, and it was decided to exempt the men until February 1st, the men to go in the meantime if substitutes were available.

At Bolton Tribunal, on November 22nd, an electrical engineer, aged 27, applied for exemption. The Assistant Military Representative strongly urged that the man should be taken for the Army on account of his age. The man's father said if he were taken the business, in which all his life's savings were invested, would be ruined. Exemption until December 31st.

Mr. G. H. Baker appealed at Bexhill-on-Sea for F. W. Climpson (37), electrician, who attested. Mr. Baker said that all his other men had joined up, and without Climpson he would be like a ship without a rudder. Three months were allowed.

Woking Tribunal has granted two months' exemption to J. S. Fowler (23), electrician, appealed for by the Electric Supply Co., Ltd.

At Eastleigh, on November 21st, the British Westinghouse Electric and Manufacturing Co., Ltd., appealed for six men engaged on work at Eastleigh in connection with the electrification of the London & South-Western Railway Co.'s suburban lines. It was decided that three of the men, who are unmarried, should join up at once; the other three were allowed three months each.

Wantage Tribunal has granted exemption to March 1st to Mr. W. A. Noble (41), manager of the Tramway Co., on his joining the Volunteer Defence Corps; the same term to J. R. Wilkins (32), fitter and erector, appealed for by the company; and to January 15th to R. Skinner (32), tramway conductor.

BUSINESS NOTES.

Lamp Manufacture in the U.S.A.—Licences to manufacture tungsten filament lamps under the Just and Hanaman patents are being issued by the General Electric Co., of Schenectady, owners of the patents, the validity of which has been recognised by the U.S. Courts. The owners could have shut down the independent lamp makers, but preferred to issue licences rather than to destroy the capital invested in their businesses. The licences permit the licensees to continue to manufacture lamps up to the same percentage of the General Electric Co.'s output in any year as they were manufacturing in 1915. The licensees are not restricted as to selling prices, but must not use the trade name "Mazda," and will not have the benefit of the research work carried on by the owners of the patent.

The effect of the decision is to put an end to the importation of tungsten-filament lamps into the United States. The *Electrical World* states that the Laco-Phillips Co., the defendants in the case, who were large importers of lamps from Holland, have gone out of business so far as the United States is concerned. Before the war there was a very appreciable trade in foreign-made lamps, mostly of the miniature type; but in September, 1914, the price of American lamps was lowered to a value that could not be met by foreign manufacturers.

Book Notices.—"*Proceedings* of the American Institute of Electrical Engineers." Vol. XXXV. No. 11. November, 1916. New York: The Institute. $1.

"Scientific Papers of the Bureau of Standards." No. 294. "Freezing Point of Mercury." Washington: Department of Commerce.

"Spon's Electrical Pocket Book." By W. H. Molesworth. London: E. & F. N. Spon. Price 6s. net.

Trade Announcements.—Messrs. Albert Dickinson, Ltd., of 19, Upper Mill Hill, Boar Lane, Leeds, have circularised their customers, stating that owing to the pressure of military necessity they are compelled temporarily to suspend operations. They have arranged with Messrs. Wallis & Watson, of 26, Park Row, Leeds, to take over the business *pro tem.*

New offices and showrooms for the electricity department, have been opened at 1, St. James's Street, by the Taunton T.C.

To meet the demands of increasing business, the directors of the Vulcan Boiler and General Insurance Co., Ltd., have decided upon certain rearrangements of, and additions to, the official staff at the head office, which will in future be constituted as follows:—C. Bullock, Wh.Sch., A.M.Inst.C.E., managing engineer; J. M. Dale, F.C.I.S., managing secretary; Frank H. Bullock, A.M.Inst.C.E., deputy managing engineer; G. R. Vine, assistant secretary and accountant; R. Quinney, assistant secretary and agency superintendent; J. Cauthery, chief boiler engineer; E. H. Scholes, departmental chief, consultative department.

The Indo-European Telegraph Co., Ltd., announce that the whole of the radio-telegraphic business hitherto carried on by that company has been transferred to Messrs. Creed & Co., Ltd., telegraph engineers, East Croydon, to whom should be addressed all communications on subjects previously dealt with by the company. The board of directors of Creed & Co., Ltd. (until recently known as Creed, Bille & Co., Ltd.) has been enlarged to accommodate, amongst others, two directors of the Indo-European Telegraph Co., Ltd. A fuller announcement concerning Messrs. Creed & Co.'s developments appeared in our issue of November 17th, page 545.

Dissolutions and Liquidations.—Shaw Wireless, Ltd.—According to an Australian paper, this company is winding-up voluntarily, with Mr. L. J. D'Antoine, of T. and G. Buildings, Elizabeth Street, Sydney, as liquidator.

Goodenough & Skinner, motor engineers, electricians, &c., 62, Hampton Road, Redland, Bristol.—Messrs. W. D. Goodenough and J. B. Skinner have dissolved partnership. Mr. Goodenough attends to debts, &c., and will continue the business.

Leitner Electrical Co., Ltd., Maybury, Woking.—December 14th is the last day for receipt of proofs for dividend. Liquidator, Mr. G. E. Corfield, 119, Finsbury Pavement, E.C.

Patents and Alien Enemies.—Application has been made to the Board of Trade by the North British Rubber Co., Ltd., for the avoidance or suspension of Patents Nos. 11,530/13 and 11,615/13, granted to Farbenfabriken vorm. Friedr. Bayer & Co. for the vulcanisation of rubber; the hearing was fixed for yesterday.

Applications for the grant of licences in respect of Patents Nos. 12,777/13 and 12,661/14, granted to Newton on behalf of the same alien firm and in respect of the same subject, have also been made by the North British Rubber Co., Ltd., and were to be heard yesterday.

The suspension order dated August 17th, 1915, granted to Messrs. G. H. Forrester and G. Marsh in respect of Patents Nos. 12,868/05, 12,869/05, and 12,870/05, for the detinning of tin plates, has been revoked.

Patent Restoration.—Application has been made by L. St. C. Brach for the restoration of Patent No. 18,513 of 1911 for "Improvements in soldering composition paste."

Catalogues and Lists.—Messrs. F. Husband, Ltd., Craven House, Kingsway, London, W.C.—Illustrated circulars giving prices and particulars of Husband-Quead electric fires and Ensign electric fires.

The B.T.H. Co., Ltd., of 77, Upper Thames Street, E.C., have issued the first of a series of incandescent lamp handbooks. It gives a great deal of information and data regarding Mazda lamps of both vacuum and half-watt types, suitable for general illumination, train lighting, projector work, &c. There is also a glossary of technical terms used in connection with glow lamps, as well as rules and terms for the sale of Mazda lamps to private consumers, trade users and re-sellers. The handbook (56 pages) illustrates to scale all the forms of standard lighting lamps falling under the heading of Group I, and gives detail of size, type of cap, efficiency, wattage, voltage range, illuminating output in lumens, standard packing quantities, &c. Readers who have not received copies can have same on application.

The Sterling Telephone and Electric Co., Ltd., 210-212, Tottenham Court Road, London, W.—Publication No. 254 (eight pages) containing a description of their mining bells and relays, specially constructed with parallel windings for use in fiery mines, in order to comply with the new Home Office Regulations.

General Electric Co., Ltd., 67, Queen Victoria Street, London, E.C.—A folder (O.S. 2,061) has been issued, giving prices of Osram drawn-wire lamps. It bears the coloured "Elephant" design "Osram the Strong," already referred to in these columns. Copies are being supplied to the trade, overprinted with their name and address. The company has also issued to the trade an effective window bill (20 in. × 30 in.) of the same design.

LIGHTING AND POWER NOTES.

Australia.—The N.S.W. Public Works Department is making inquiries in connection with the proposed electric lighting scheme for Wollongong. The Department has in hand a comprehensive scheme for lighting the towns on the south coast, and on the table lands from the power house at Port Kembla, and probably before long Bowral, Moss Vale, Mittagong, and the mountain towns may be lighted from this source. The price of materials is chiefly retarding the negotiations.

The Melbourne (Victoria) City Council has been advised by the Electric Supply Committee that it has been found necessary to install an additional 5,000-KW. generating plant, so that it may be in operation during the winter of 1918; the cost is estimated at £22,500. The demand for power is increasing at the rate of 20 per cent. yearly, and it is expected that the same rate of expansion will continue in the future. Tenders are to be invited for the plant.—*Tenders.*

A deputation recently waited on Mr. H. McKenzie, Minister of Water Supply, with a view to securing extended rights to the use of the water of the Kiewa River for hydro-electric power. The proposal is to establish on the higher reaches of the Kiewa River hydro-electric works to distribute electricity in the country districts and down as far as Melbourne. Under the Water Act the syndicate could only secure a 15 years' lease, and it is desired to have this extended to 50 years.

A special Act of Parliament would be necessary, and the deputation asked that provision might be made for the Government to fix the prices of supply, and for the State to take over the whole concern if thought fit.

The Minister said the Water Commission had no objection to the syndicate using the water for power production; he could not hold out any hope that a Bill could be introduced this season, but he would bring the request before the Cabinet.

The Brunswick City Council is raising a loan of £7,500, of which £5,000 will be devoted to extending the electric lighting throughout the municipality.—*Melbourne Age.*

A representative deputation has interviewed the Victorian Premier to protest against any proposal to compulsorily take over the Melbourne City Council's electricity undertaking and place it under the control of a proposed tramway trust. The Premier mentioned that a Sub-Committee had been appointed to consider the matter and prepare a draft Bill; no decision had been come to, and he promised that the representations of the Committee should be considered.

Baildon (Yorks.).—PROV. ORDER.—The B. of T. has agreed to extend the powers obtained by the Council in 1913 in respect of the supply of electricity; the matter has arisen owing to a recent proposal to supply electricity in the district.

Bingley.—The D.C. has resolved upon the adoption of the maximum demand system as an alternative system of charging for energy supplied for lighting; also to charge for energy supplied for power £3 per annum per metered H.P. required, plus 1d. per unit supplied.

Birmingham.—In order to enable the Electric Supply Committee to give the necessary supply of electricity to the tramways, it is suggested that the power load should be reorganised, and if the necessary approval can be obtained, it is hoped that the tramway difficulty will be overcome.

Bury.—LINKING-UP.—The chairman and deputy-chairman of the Electricity Committee, the town clerk and the electrical engineer have been deputed to attend any conferences which might be held on the question of interconnection of electrical undertakings in the district, the Committee being in agreement with the general idea.

Cahirciveen (Co. Kerry).—E.L. SCHEME.—A public meeting decided to urge the Council to adopt an electric lighting scheme for the town.

Chile.—Permission has been granted to Senor Victor Leon Nunez to utilise the Rio Chillan for the production of power required in connection with the electric lighting of the town of Chillan.—*Board of Trade Journal.*

Colombia.—The Municipal Council of Pensilvania, Department of Caldas, has been authorised to raise a loan of £3,000 for an electric power plant; the Municipal Council of Angostura, Department of Antioquia, to raise a loan of £800 for an electric power installation; and the Municipal Council of Venecia, Department of Antioquia, to raise a loan of £1,000 for an electric power plant and aqueduct works.—*Board of Trade Journal.*

Continental.—AUSTRO-HUNGARY.—Owing to the serious condition of the Buda-Pesth finances, the Municipal Council has decided to raise the prices of gas, electric light, and water, hoping to raise an additional revenue of £300,000 to £330,000.—*Times.*

SPAIN.—La Sociedad Energia Electrica Cataluna, of Barcelona, has applied to the authorities of the Province of Lerida for a concession to establish a hydro-electric plant of about 4,800 H.P. on the River Noguera de Cardos, near Tirvia.

PORTUGAL.—Concessions have been granted to Senhor Martinho Pinto de Miranda Montenegro, of Castelo de Paiva, to use the Rio Paiva, at two different points in the Aveiro district, for the generation of electrical energy. Two hydro-electric power stations are to be established, each having three sets of turbo-generators; each turbine is to be of 3,800 H.P.—*Board of Trade Journal.*

Cork.—The Trafford Co., Manchester, a branch of the Ford motor concern, U.S.A., is in negotiation for the establishment of works which it is expected will involve an extension of electric lighting and power.

Dover.—The T.C. has further postponed the question of installing a new turbine set in place of the smaller sets at the electricity works. The question was held over a year ago. An additional loan of £3,884 to meet the cost of laying a new cable to East Cliff is to be taken up.

Dundee.—PLANT EXTENSIONS.—The Electricity Committee of the T.C. reports that the Scottish Office has sanctioned the expenditure of £27,000 for proposed extensions, on condition that a contribution of £5,000 towards the cost of the contemplated extension is made out of revenue, and that provision is made for reduction of the loans raised under the present sanction by setting aside annually to a sinking fund not less than 4 per cent. of the amount borrowed.

Epsom.—PROVISIONAL ORDER.—The South Metropolitan Electric Tramways and Lighting Co., Ltd., is applying for a provisional order for the supply of current in the parishes of Ewell and Cuddington, in the area of the Epsom R.D.C.

Exeter.—It was reported to the T.C. that the present stock of electrical materials cannot be increased, and that when it was used up no further E.L. connections could be made.

Falkirk.—PRICE INCREASE.—A proposal to increase the price of electricity for power by 10 per cent. is being considered by the T.C.

Llandudno.—PRICE OF ELECTRICITY.—The Electricity Committee has considered the statement showing receipts and expenditure during the year ended March 31st, and also for the half-year ended September 30th, and reports that it appears that the increasing loss on the undertaking is due to the higher price of fuel; it was therefore recommended that the Council raise the flat rate for electricity to 8d. per unit, and other rates in proportion, which, however, the Council declined to do.

London.—HAMMERSMITH.—The Electricity Committee reports that it is still in negotiation with the Battersea and Fulham B.C.'s upon the proposed linking-up scheme. In the meantime a suggestion has been received from the Fulham B.C. that the Hammersmith Council should take over some of its load for a period of six months or so, pending the carrying out of certain important alterations to the Fulham electricity works. The engineer has reported that this can be done in such a way as to form a part of the proposed larger and permanent linking-up scheme, by connecting the ordinary high-tension mains at a sub-station in the Fulham area near the Hammersmith boundary, the only apparatus to be purchased being two auto-transformers necessited by the difference in the two pressures of the respective undertakings. This will enable a temporary bulk supply of approximately 400 KW. to be given to Fulham, and the Committee recommends that it be carried out.

The Committee reports that the mains laid by the Council's contractors for the bulk supply to the Chiswick Electricity Supply Corporation are now in position and available for supply at any time.

Application is to be made for sanction to a loan of £2,000 for the purchase of cable and apparatus on the termination of the contract.

STEPNEY.—The B.C. has been recommended that all charges for electricity supplied, including meter rentals, except in cases where there are special contracts, should be increased by an additional 13⅓ per cent., making a total increase on the pre-war rates of 33⅓ per cent., to commence with, and include, the accounts to be rendered for the month of November.

Market Drayton.—The Blore Heath R.D.C. has given its consent to the Market Drayton Electric Light and Power Co. to supply electricity to Peatswood, Tyrley Castle and Tern Mill.

Midlothian.—The electrical plant of the Arniston Oil Co. is being duplicated.

New Zealand.—Mr. Evan Parry, the chief electrical engineer of the Lake Coleridge (Government hydro-electric) scheme, in his report on the year's operation to March 31st, 1916, states that 4,860,260 units were generated and 3,994,757 units sold: the maximum load was 1,328 KW., the average load 555 KW. and the load factor 41·8 per cent., while the connected load was 6,893 KW. Operating expenses amounted to £9,383, making, with depreciation and interest (£16,783), a total of £26,166. The revenue was only £8,255, resulting in a deficit on the year's working of £17,911. Three generating units were originally installed, equal to 6,000 H.P.; 12 months ago the demand for electricity warranted the installation of a fourth unit of 2,000 H.P., and the expanding business now necessitates the addition of a fifth unit of 4,000 H.P. Contracts to the extent of 8,000 H.P. have already been entered into, and when the power under these contracts is supplied it is expected that the plant will be earning sufficient to pay interest in full, as well as working expenses, and possibly leave a small surplus towards sinking fund and depreciation. The total capital expended to March 31st, 1916, was £316,797.—*Commonwealth Engineer.*

Rawtenstall.—The T.C. has received sanction to the borrowing of £107 for transformers in connection with the supply of electricity to Haslingden, and £300 for the provision of a transformer in connection with the supply to a local firm.

Tasmania.—The Government has obtained a loan of £150,000, at 6 per cent., from the Commonwealth Bank, for the Hydro-Electric Department, to enable it to supply 3,500 H.P. to the Hydro-Electric Co., 4,000 H.P. to the Amalgamated Zinc (de Baray's) Co., and 2,000 H.P. to consumers in and around Hobart.—*Commonwealth Engineer.*

West Ham.—The electrical engineer is to report on the plant capacity at the generating station, and to supply certain data in connection with the linking-up proposals.

Willesden.—It is reported that the Daylight Saving Act during the midsummer quarter reduced the private lighting revenue by £518 as compared with the previous year. During the two summer quarters 2,735,843 units were purchased from the Power Co., the average cost being, for the June quarter, ·725d. per unit; Michaelmas quarter, ·717d. per unit, being a reduction as compared with the previous year.

Application is to be made to the L.G.B. to sanction the borrowing of £5,000 for mains extensions; the Board has sanctioned a loan of £2,887 for certain urgent work.

TRAMWAY and RAILWAY NOTES.

Australia.—The quarterly report of the Prahran and Malvern Tramways Trust, to September 30th, shows that the revenue for the quarter was £33,619: the passengers carried were 5,243,875, and the car mileage, 590,515 miles. During the year ended September 30th the total number of passengers carried was 23,095,442, and the total revenue from fares was £150,444.

Having practically completed arrangements for the borrowing of £100,000, the Footscray (Victoria) Tramway Trust has decided to make an early start with the construction of four of the five short lines in the scheme, each of which has its terminus at the Footscray Railway Station; the Trust recently obtained an Order in Council authorising this work.—*Tenders.*

A deputation from the Municipal Tramways Conference recently waited on the Premier of Victoria on the question of tramway control. The deputation protested against any proposals to constitute a permanent tramway authority not composed of representatives from the Municipal Councils, and strongly objected to the proposal to take away from the Municipal Councils the ownership and control of all tramways in the metropolitan area; objection was also made to the insertion in the proposed Tramways Bill of any provision for subsidising the Railway Department out of tramway revenue.

The Premier, in reply, said that the Government was fighting for municipal ownership as against nationalisation; the real point at issue was as to the question of management. He would, however, submit the views of the deputation to his colleagues in the Cabinet. As regards the subsidy, he was afraid the deputation had not looked at it from a broad standpoint. The metropolitan area had been largely developed by the railway system at the expense of the people as a whole. If by any chance the tramways were going to compete with that system, it only seemed fair that something should be paid for the right to compete. He could not hold out any hope that the Government was likely to vary the proposals, which would be thrashed out in Parliament.—*Melbourne Age.*

The effect of the suburban electric tramway services on the railway revenue is discussed in the annual report of the Victorian Railway Commissioners, who estimate the decrease on the Essenden, Prahran-Malvern and Hawthorn-Camberwell lines at £60,945 per annum. The Commissioners say:—"So long as the existing principle governing the construction of tramways is continued, the proposition that the railways should in some way be compensated from the tramway receipts for the loss of revenue resulting from the competition of the tramways, though open to criticism, is, perhaps, on the whole, an equitable arrangement, but they consider that the adoption of such a scheme should not be regarded as finally disposing of the problem arising from the conflicting interests of the railway and tramway systems."

The Commissioners express the belief that much of the traffic lost will be regained after the suburban lines are electrified.—*Commonwealth Engineer.*

Bradford.—Ticket Boxes.—The practice of the Tramway Department of attaching boxes for used tickets to the cars, results in the saving of 12 tons of used tickets yearly, which will sell for £2 per ton.

The Tramways Committee has decided that the tramway service of the city shall be entirely suspended on Christmas Day.

A Sub-Committee has been appointed to meet the trainway workers in connection with applications by several sections of the staff for advanced wages.

Continental.—Spain.—The *Gaceta de Madrid* publishes a notice authorising the Sociedad Tranvia del Este de Madrid to undertake the construction and working of an electric tramway in Madrid from the Calle de Alcad to the Calle de Diego de Léon.—*Board of Trade Journal.*

Dublin.—The Dublin (Electric) Tramways Co. last week inaugurated a new service between Westland Row and Fair View, linking up the Dublin and South-Eastern Railway and Great Northern Railway termini.

Halifax.—The Tramways and Watch Committees have decided to make representations in the proper quarters for more light in the streets and for power to have better head lights on the cars, owing to serious nerve strain on the tramcar drivers.

The attitude of the Committees in appealing to the lighting powers for some moderation of the lighting restrictions, is endorsed throughout the cities and towns of the West Riding, where an agitation for better street lighting has recently been spreading amongst local authorities, the view being that the restrictions are excessive and cause dangers out of all proportion to the purposes of the restrictions.

Lancaster.—Electric 'buses.—Two Edison battery 'buses, each to accommodate 22 passengers, and having a speed of 12 miles an hour, have been delivered to the Corporation. The chassis of a third 'bus was lost at sea; all the bodies were supplied by the Brush Co.

Newcastle.—As the result of a conference between the Tramways Committee and the managers of the amusement houses in the city last week, it was decided to stop all cars at 10 o'clock. It was explained that the strain upon the tramway employés had reached breaking point.

Rawtenstall.—Wages.—The T.C. on Thursday decided that in future there should be no war bonus for tramway employés, and in lieu thereof drivers and conductors will receive ½d. an hour more than at present and the shedmen 1d. an hour more.

TELEGRAPH and TELEPHONE NOTES.

Bolivia.—A radiographic station was inaugurated last Saturday at Viacha, which permits of wireless communication between Bolivia and Argentina.—*Review of the River Plate.*

German Wireless.—It is reported that during October 300,000 words were sent over the German wireless routes to America. During the winter, improvements and enlargements of the principal stations will enable the service to be still further increased.

It is reported that a Dutch company is being formed with the support of various big shipowners for the manufacture of apparatus for wireless installations on board Dutch and other ships, with a view to being independent of the British Marconi Co. and the German Telefunken Co.—*The Times.*

New Zealand.—The N.Z. Government is negotiating with the Eastern Extension Cable Co. with a view to the removal of the cable station from Wakapuaka to Wellington. The Auckland wireless station, which has been closed since May, 1915, has been reopened, and the Government has decided to erect a station at Rarotonga.—*T. and T. Age.*

South America.—The Western Union Telegraph Co. is making arrangements to extend its activities to South American countries, which at present are connected with the United States only through the Central and South American Telegraph Co.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Sydney.—January 3rd. N.S.W. Railways and Tramways Department. 50-ton electric overhead travelling crane for Yarra Street power-house, Newcastle.*

January 8th. Municipal Council Electric Lighting Department. 33,000-volt switchgear. E.L. Department, Town Hall. Specification 10s. 6d.*

January 22nd. Electrical plant (converter, battery, booster, and switchboards) for the Castlereagh Street sub-station, for the Municipal Council. Specification from E.L. Department, Town Hall.*

Queensland.—December 12th. P.M.G.'s Department. Caps and lamps for switchboard, covered wire, benders, sleeves and tapes. See "Official Notices" to-day.

January 1st. P.M.G.'s Department. Cords, switchboard, parts and accessories, measuring instruments and telegraph instruments. See "Official Notices" to-day.

Bingley.—D.C. Electric light installation at Public Baths. The Engineer, Council Offices.

Bradford.—December 5th. Motor-driven or other mechanically propelled road-sweeping machines. W. H. Inger, Superintendent to Street Cleansing Department, Harris Street.

Cape Town.—January 5th. Electric motors and starting panels, for the Corporation Electricity Department. Dock Road, Cape Town.*

Durban.—January 3rd. Corporation. One 3,000-KW. steam turbine, alternator, and condensing plant. Specification No. S. 238; drawing No. P. 597, both at the office of the Borough Electrical Engineer, Municipal Buildings. Deposit £2 2s.

Enniskillen.—December 1st. Sligo, Leitrim & Northern Counties Railway Co. Twelve months' supply of telegraph materials. Mr. J. Duff, Secretary to the Company.

Grenada.—December 31st. Government. Electric supply at St. George's and suburbs. Tenders to Colonial Secretary, Grenada, British West Indies.

Johannesburg.—December 9th. Corporation. 1,427 A.C. and D.C. electricity meters and 100 time-switches. Specification (21s. deposit) from Mr. E. T. Price, General Manager's Office, Electricity Supply and Tramways Department, President Street, Johannesburg, W.*

December 20th. Corporation. Automatic pressure regulators for the A.C. turbo-generators at the power station.*

January 3rd. Corporation. Iron axles and bushes.*

London.—L.C.C.—The Stores and Contracts Committee recommends that the Committee be authorised to open the tenders to be received on December 5th for the supply of electric traction glow-lamps for the Tramways Department under Schedule 17 D.

The Highways Committee recommends that tenders be invited for the supply of about 3,000 yards of trolley wire for tramway purposes.

New Zealand.—DUNEDIN.—January 24th. Motor-generator, accessories and spares. City Electrical Engineer, Market Street, Dunedin.*

TAURANGA.—February 12th. Borough Council. Supply of six three-phase transformers, 11,000-400 volts. H. W. Clime & Sons, Consulting Engineers, Raetihi.—*N.Z. Shipping and Commerce.*

Spain.—The municipal authorities of Alberique (Province of Valencia) have just invited tenders for the concession for the electric lighting of the town during a period of five years. The electric lighting contract for a period of one year in the town of Albarda, in the same province, was also lately up for tender.

Trimdon Grange (Co. Durham).—December 3rd. Six months' supply of electric fittings. Storekeeper, Trimdon Grange Colliery.

Warrington.—December 12th. Electricity and Tramways Committee. Twelve months' supply of earthenware conduit. See "Official Notices" to-day.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Department in London

CLOSED.

Australia.—P.M.G.'s Department, N.S.W.:—

12⅞ miles of paper-insulated lead-covered cable, 100 pairs, £20,489.—B.I. & Helsby Cables, Ltd.

P.M.G.'s Department, Victoria:—

One Wheatstone transmitter and one ditto receiver, £167.—Messrs. Noyes Bros. (Sydney), Ltd.

Trades and Customs Department:—

Wireless apparatus for use of the lighthouse service, £895.—Messrs. G. Weymouth Pty., Ltd.

Home Affairs Department:—

Installation of electric lighting plant at North Head quarantine station, £426.—Messrs. Sutherland & Ashman Pty., Ltd.

Glasgow.—The Tramways Committee recommends acceptance of the following:—

Chilled brake-blocks (three months' contract).—Miller & Co., Ltd.
Glass (three months' contract).—Pilkington Bros.
Glass (six months' contract).—Chance Bros., Ltd.
Car-wheel tires (six months' contract).—Brown, Bayley's Steel Works, Ltd.
Malleable castings (six months' contract).—Alex. Shanks & Son, Ltd.
Iron and steel bars (six months' contract).—P. & W. MacLellan, Ltd.
Springs (six months' contract).—L. Sterne & Co., Ltd.
Oils (six months' contract).—John Murray & Son, Ltd.; Marks & Johnston; and J. & D. Hamilton, Ltd.
Paints (six months' contract).—Blacklock & M'Arthur; Hird, Hastie & Co.; J. S. Craig & Co., Ltd.; and Lewis Berger & Sons.
Iron and steel scrap for disposal (six months' contract).—John Jackson and Co.; P. & W. MacLellan, Ltd.; and David Smith.

London.—HAMMERSMITH.—The Electricity Committee recommends that the Main Colliery Co., Ltd., be paid the authorised increase of 2s. 6d. per ton for all deliveries subsequent to June 1st, 1916, under their contract for the supply of Welsh steam coal, with the exception of deliveries which should have taken place prior to that date; and that their contract for the supply and delivery of 150 tons weekly of Welsh coal be extended for a further 12 months from November 1st, 1916, at the price of 28s. 2½d. per ton; and that the offer of Messrs. Cory Bros. & Co. to continue the supply of 100 tons weekly for a further six months from January 1st, 1917, of Aberclwyd rough small coal, at 27s. per ton, be accepted.

Rawtenstall.—Corporation. 4,000 tons of slack for the electricity works: J. Morris & Co.

FORTHCOMING EVENTS.

Salford Technical and Engineering Association.—Saturday, December 2nd. At 3 p.m. Visit to Messrs. Lancaster & Tonge, The Lancaster Works, Pendleton. At 6.30 p.m., at the Royal Technical Institute, annual general meeting.

Royal Society of Arts.—Monday, December 4th. At 5 p.m. At John Street, Adelphi, W.C. Howard Lecture, "Coal and its Economic Utilisation," by Prof. J. S. Brame.

Institution of Post Office Electrical Engineers (London Centre).—Monday, December 4th. At 6 p.m. At the Institution of Electrical Engineers, Victoria Embankment, W.C. Paper on "The Western Electric Co.'s Auto-Tele. System," by Mr. B. O. Anson.

Institution of Civil Engineers of Ireland.—Monday, December 4th. At 8 p.m. At 35, Dawson Street, Dublin. Ordinary meeting.

Engineers' Club.—Tuesday, December 5th. At 7.30 p.m. At Albert Square, Manchester. Debate on "The Decimal System," to be opened by Mr. E. C. Barton.

Greenock Electrical Society.—Tuesday, December 5th. At 7 p.m. Visit to Messrs. John Drummond & Sons, Rue-End Street.

Institution of Civil Engineers.—Tuesday, December 5th. At 5.30 p.m. At Great George Street, Westminster, S.W. Discussion on paper "Keadby Bridge," by Mr. J. B. Ball; and paper on "Experiments on Earth Pressures," by Mr. P. M. Crosthwaite.

Rontgen Society.—Tuesday, December 5th. At 8.15 p.m. At the Institution of Electrical Engineers, Victoria Embankment, W.C. Ordinary meeting.

Institution of Electrical Engineers (Birmingham Local Section).—Wednesday, December 6th. At 7 p.m. At the University, Edmund Street. Paper on "The Parallel Operation of Electric Power Stations," by Mr. J. S. Peck.

Chemical Society.—Thursday, November 7th. At 8 p.m. At Burlington House, Piccadilly. Ordinary scientific meeting.

NOTES.

"Safety First."—A movement is on foot to carry out a "Safety First" campaign for the London area, and a Conference will be held at Caxton Hall, Westminster, this afternoon, at 3 o'clock, to explain the objects of the campaign and to elect a Council. The notice convening the meeting is signed by Mr. H. E. Blain, operating manager of the London General Omnibus Co., Ltd., and London Underground Railways, and the main purpose of the movement is to reduce the dangers to passengers and pedestrians arising from the existing condition of traffic in the streets by organising a scheme for the education of the public and the instruction of employés.

The Marconi and Telefunken Companies.—In reply to questions in the House of Commons, on Tuesday and Wednesday last, Mr. J. A. Pease stated that the Government were satisfied that there had been no connection between the Marconi and Telefunken Companies since the war began. He had seen the agreement which existed between them before the war, and found that, as the company had stated, it solely regulated rival interests, and did not enable the Germans to obtain information which they could not otherwise secure. The operators on British ships were British subjects, and in no case of enemy parentage.

The Coal Trouble in Australia.—The *Times* states that it is now a punishable offence in Australia for any electric undertaking or gas company, without official consent, to supply motive power to any unspecified industry. Specified industries are those connected with the public services. Coal and coke may not be used for industrial purposes except by special permit.

Sale of Enemy Holdings.—From an advertisement which appears in our pages to-day, it will be observed that the Public Trustee is inviting tenders for the purchase of 2,099 ordinary shares of £1 each in the Flottmann Engineering Co., Ltd., Cardiff, makers of Flottmann compressed-air hammer drills.

Whist Drive.—The Meter Department of Messrs. Ferranti, Ltd., Hollinwood, held a very successful whist drive and dance on Saturday, November 25th, at Copster Hall, Oldham. Mr. O. Coupe presented the prizes. Refreshments were served, and dancing was afterwards enjoyed. Mr. C. Finch conducted the drive. Mr. F. Buckley officiated as M.C. Mr. N. Collinson proved a capable pianist. The profit is to be handed over to the Soldiers' Fund.

Export Prohibitions.—A Supplement to the *Board of Trade Journal* of November 30th contains complete lists of articles which, according to the latest information received by the Board of Trade, are prohibited to be exported from Norway, Portugal, Roumania, Russia, Spain, Sweden and Switzerland. This Supplement also contain a reprint of the United Kingdom Contraband List.

Fatalities.—An inquest was held at Eston, near Middlesbrough, last week, into the death of a mechanical engineer named Walker, aged 23, who met his death at the steel works of Messrs. Bolckow, Vaughan & Co., Ltd. It was stated that deceased was called to attend to the coupling on the top of the electric crane. To do so he had to get into the cabin of the crane, and he attempted to do this by stepping from the platform, as was customary, instead of getting in by the steps provided for that purpose. He hung on to a girder, but being short in stature, he was unable to reach the box. He swung his body, and the result was that his heel came into contact with a live wire, and he fell to the ground, a distance of 20 ft. Verdict: "Accidental death."

A workman was killed at the works of Messrs. Thwaites Bros., ironfounders, Bradford, on the 22nd inst. His arm came in contact with the feed arm of an electric arc furnace on which he was engaged, and he died before reaching the infirmary.

High-Temperature v. Low-Temperature Carbonisation of Coal.—Our contemporary, the *Iron and Coal Trades Review*, in the course of some notes on by-product coking and to the publicity which has recently been given to low-temperature carbonisation of coal, remarks that :—"As far as the electrical side of the matter is concerned, the proposition resolves itself solely into one of power-raising, and it can in no sense be regarded as a vindication of low-temperature carbonisation plants of this or any other system. An array of figures has been put forward purporting to show that on these lines low-temperature carbonisation will solve all our fuel problems, whereas, as a matter of fact, either a Mond gas-producer plant or a coke-oven plant will produce equally good or better results. To the electrical engineers it is merely a question of getting a supply of fuel at a rate slightly less than they are compelled to pay at present. All low-temperature carbonisation plants suffer from one great drawback, viz., they have in themselves no satisfactory outlet for their gas, and hence as an alternative to wasting it, they can afford to sell it at a very low price. Carbonisation at gasworks and also at coke-oven plants is economically a success, but until conditions alter greatly, low-temperature carbonisation cannot be. At a gasworks, the revenue per ton of coal is derived approximately in the following way : From the coke, three-eighths : from the gas, a half ; from the by-products, one-eighth. On a coke-oven plant, the proportions may be taken as—coke, four-fifths ; gas, one thirty-fifth ; by-products, six thirty-fifths, the proportion for gas being almost negligible. Now, with a low-temperature carbonisation plant, the results are not comparable with a gasworks from the point of view of revenue, because the gas cannot be sold at anything approaching the figure for town gas. If we allow—and this allowance cannot be justified as yet—a higher price for the low-temperature coke, and also a slight increase from by-products, the total increase by no means balances the decrease due to the low value of the gas. Hence, from the revenue point of view, gasworks have nothing to gain by substituting low-temperature carbonisation for their present system. Again, comparing with coke ovens, low-temperature coke has not nearly the same value as coke-oven coke ; the gas is worth no more than the coke-oven gas, and it is very questionable if the by-products are worth as much as those obtained in a by-product coking plant. It will be seen, then, that the balance is against low-temperature carbonisation in this connection also. As a purely carbonising proposition, then, low-temperature carbonisation cannot compete with gasworks or coke-ovens."

Referring to the Brighton Corporation proposal, it says :—"From the point of view of the Brighton Corporation, the scheme is merely one of gas firing. The whole onus of the carbonisation side is thrown on the Coalite Co., and all that the Corporation has to do is to utilise the gas. The gas is to be a mixture of coal gas and producer gas, and will have a calorific value of approximately 300 B.TH.U. per cb. ft. Approximately 40 cb. ft. are required to give the same heating value as 1 lb. of the coal. According to the calculations of Mr. Christie, the Brighton electrical engineer, at the price which the Coalite Co. offer the gas, the Corporation will obtain for 11s. 3d. the same quantity of heat as they get in a ton of coal at 20s. It is estimated that 110 cb. ft. of gas will be required per KW.-hour, and that, with an annual production of 7½ million Board of Trade units, the cost of fuel per unit will be reduced from 0·321d. when using coal to 0·165d. when using gas. There is also a certain saving in other directions, as with gas-firing no labour is required for coal-handling, clinkering, &c. The only factor necessary for the complete success of the scheme is the successful operation of the Coalite plant, and this appears to be the weak link in the chain."

The Engineers' Club, Manchester.—In addition to the events announced in our last issue, the following further debates have also been arranged for [Tuesdays, at 7.30 p.m. Dinner served from 6 p.m. Price 2s. 6d.] :—

January 9th.—"The Magneto in Peace and War." Opened by Lieut.-Commander W. A. Bristow, R.N.V.R.
January 23rd.—"The Empire's Metals and the German Octopus." Opened by T. S. Bangham.
February 6th.—"Enemy Influences in Great Britain and their Effect." Opened by Stafford Ransome, Secretary, the British Engineers' Association.
February 20th.—"The Engineers' Club : What It Is, and What it Might Be" Opened by Edmund L. Hill.
March 6th.—"Engineering and Imperial Production." Opened by T. C. Elder.
March 20th.—"German Banking." Opened by J. Drummond Paton.

The Edison Battery.—According to reports from America, the Edison Battery Co. is at work on an improved form of its nickel-iron-alkali accumulator, which, while being on the same lines, generally speaking, will have the advantage of a higher voltage per cell.

Electric Vehicle Committee.—At the last meeting, Mr. E. S. Shrapnell-Smith presiding, Mr. J. A. Priestley, representing the Institute of Cleansing Superintendents, took his seat for the first time.

In the course of an interesting discussion, Mr. Harrison, borough engineer of Southwark, explained why he had reported recently against the use of electric vehicles for certain work for which he proposed using motor traction. This was owing to there being no electric vehicle on the market which complied with the requirement that the loading rail of the body should not be higher than 4 ft. 6 in. above the road level. The particular purpose in view was the quick and easy removal of street sweepings from the depôts or stands in the streets where they are collected, and the collection of house refuse.

In connection with the provision of charging facilities on the route from London to Birmingham, correspondence was read from the electric supply department of the City of Coventry, setting forth that they were unable to give any facilities for charging, and from the manager of the Northampton Electric Light and Power Co., promising to afford every possible facility for charging vehicles, and stating that when the amount of business warrants it they will consider putting down a proper charging plant. They have decided to adopt the E.V.C. standard tariff.

The secretary was instructed to lay before the Ministry of Munitions the views of the Committee as to permission being granted to British electric vehicle manufacturers to continue manufacturing electric vehicles for commercial purposes.

It was decided to invite the Institute of Automobile Engineers and the British Rubber Tyre Manufacturers' Association to nominate a representative upon the Committee ; it was also decided that the official designation of the Committee in future should be : "The Electric Vehicle Committee of Great Britain, formed under the auspices of the Incorporated Municipal Electrical Association."

A communication was received from the Anderson Electric Car Co., of Detroit, stating that they were arranging to fit the E.V.C. standard plug to all electric vehicles exported to Great Britain and France.

It was decided to recommend to the Accumulator Section of the B.E.A.M.A. that in the case of lead-plate batteries on electric vehicles, the upper and lower limits of sp.g. should be clearly marked in raised or moulded letters on the battery.

Linking-up Electricity Stations.—An important meeting was held on November 21st last at the South Wales Institute of Engineers, Cardiff, of representatives of the electricity supply undertakings in the district in order to form a Local Committee for South Wales and Monmouthshire, and to consider with regard to linking-up existing electric power stations, in the national interest. The meeting was convened by Mr. W. A. Chamen, of Cardiff, chairman of the Joint Committee dealing with this subject It was resolved that the Committee should consist of all the representatives invited to the meeting. Mr. Arthur Ellis, Cardiff, was elected chairman and Mr. Lewis W. Dixon, Merthyr, vice-chairman and hon. secretary, and the following gentlemen were elected members of a Sub-Committee :—Mr. W. A. Chamen (South Wales Power Distribution Co.), Mr. William Burr (Swansea), Mr. A. Nichols Moore (Newport), Mr. G. H. Thomson (Neath), Mr. J. E. Teasdel (Pontypridd), Mr. J. M. Bowman (Porth) and Mr. J. C. Howell (Llanelly). The secretary was instructed to obtain necessary information, &c., and to arrange a meeting of the Sub-Committee as soon as the information is obtained, in order to consider further steps.

Electrolytic Zinc.—The first of five sections, composing the new zinc refinery of the Anaconda Copper Mining Co., at Great Falls, Montana, was placed in operation on September 11th. The first stripping of the plates netted 25 tons of zinc that was sent to furnaces at Anaconda for transforming into the commercial article. The two new 50-ton furnaces that are to handle the output at Great Falls are being constructed and, according to the New York *Engineering and Mining Journal*, would be ready for operation about October 1st. By that time it was also expected that two additional units would be operating at the refinery, and by November 1st the entire plant, with a capacity of 5,000,000 lb. to 6,000,000 lb. of high-grade zinc per month, should be in operation.

The first week's trial of the new plant proved most satisfactory. The zinc is brought in concentrates from the new concentrator at Anaconda. On arrival at Great Falls it is taken first to the roaster, where it is changed into calcines. This fine powder carries, in addition to zinc, copper, lead, silver and gold. It is next distributed to leaching tanks having a depth of 20 ft. and a diameter of 10 ft. In these it is agitated in acid solution by compressed air forced in from below. After agitation the pulp passes into Dorr thickeners, where the lighter solution containing most of the zinc is drawn off and filtered, the pregnant solution being pumped into storage tanks in the refinery proper, and sent from there to the electrolytic tanks. These are arranged end to end with six tanks in each battery, the solution cascading from tank to tank. Each tank is 5 ft. long, 3 ft. wide and 3 ft. deep, and contains 28 lead anodes and 27 cathodes consisting of aluminium plates, upon which the zinc forms. The zinc is 99·9 per cent. pure.

Ground for the new plant was broken on January 1st of this year, and close on $3,000,000 has been expended in the construction and equipment of this department. The aluminium cathodes for the electrolytic tanks alone represent an investment of nearly $500,000. Each one contains 14 lb. of aluminium and 16 lb. of copper, and there are 20,000 of these in the five sections of the new plant. The copper metal for each cathode is worth between $4 and $5. In addition, there is the expense of manufacture. The plant will use 33,000 H.P. when it is operating at capacity. This power will come from the Rainbow and Big Falls plants of the Montana Power Co., situated within 10 miles of the new refinery. The concentrator at Anaconda is completed, and there will be no lack of zinc concentrates for the new refinery as soon as the additional units are put into operation. By November 1st it was estimated that fully 2,000 tons of zinc ores per day would be used for this new department.—*Financial Times.*

Copper Prices.—THE WEEK'S CHANGES.—Messrs. F. Smith & Co. report, Wednesday, November 29th :—Electrolytic bars rose from £160 to £167 ; ditto sheets, from £178 to £185 ; ditto rods, from £169 to £176 ; ditto H.C. wire, from 1s. 8d. to 1s. 8¼d ; silicium bronze wire, from 1s. 10½d. to 1s. 11½d.

Messrs. James & Shakespeare report, Wednesday, November 29th :—Copper bars (best selected), sheets and rods rose from £171 to £187.

Inquiries.—Makers of the "Rex" electric brush and "Barker" electric hair drier, of ball and socket insulating beads, and of a wrist light, complete with battery and lamp (for ambulance purposes), are asked for.

Legal.—WINN *v.* CLARK.—In the City of London Court, on Monday, before Mr. E. B. Tattershall, the Assistant Registrar, Mr. Edward Winn, of Copthall House, E.C., sued Mr. John H. Clark, of 144-146, Bethnal Green Road, for £17 6s. 9d. for electrical work done and material supplied at his place of business. Instructions for the work were given by the defendant to the plaintiff's foreman, and an estimate was given amounting to £8 15s., but during the carrying-out of the work the defendant gave orders for extra work and alterations outside the items of the estimate, which necessitated extra labour, time and materials. This increased the original quotation from the £8 15s. to the amount now claimed. The case had been before the Judge, and the defendant was found liable, and the question of the amount had been referred to the Assistant Registrar to ascertain what was due to the plaintiff. After hearing the evidence, the Assistant Registrar said he thought the work was properly done, and he could find no objection to the charges for material, but with regard to the hours of labour and the evidence as to the fair number of hours, he was disposed to think 100 hours sufficient, instead of the 140 charged, and he would find for the plaintiff for that time. He must therefore submit to a deduction of £2 10s. for the overcharge of 40 hours. Judgment for the plaintiff for £14 16s., and costs.

LOWE *v.* BLUNDELL.—In the Court of Appeal, November 28th, before Lords Justices Swinfen Eady and Bankes, and Mr. Justice Lawrence, this case was down for hearing, on the application of defendant for judgment or new trial, on appeal from verdict and judgment at trial before Mr. Justice Ridley and a special jury in March last.

The matter was mentioned to the Court on November 17th, when, on a suggestion of the Court, the appeal stood over with a view to settlement.

Mr. Parfitt, K.C., now said that since the adjournment of 10 days granted, the parties had had an opportunity of considering the figures which their Lordships had kindly helped them with, and the matter had now been settled in terms endorsed on counsel's brief. The only order he asked for was for payment out to the respondent Lowe of £350, which was part of the £1,000 paid into Court, and the balance to be paid out to the appellant, Mr. Weld Blundell himself.

Lord Justice Swinfen Eady: Out of the money in Court pay £350 to the plaintiff, and the balance of £1,000 to the defendant; no other order.

Mr. Parfitt: Yes.

Mr. Coles Preedy said he appeared on behalf of Mr. Lowe, who was grateful to their Lordships for their suggestion of a sum, which he felt he ought to act upon. He had no desire to make money, but to vindicate his honour, which he hoped he had done by the verdict of the jury.

Lord Justice Swinfen Eady, in assenting, said it was a wise settlement on both sides.

Central-Station Men and Military Service.—At the Swindon Tribunal, S. Bowler (29), single, stoker; Frederick Newey (22), married, electrical engineer; George Frederick Lane (22), single, electrical engineer; and H. F. Grimes (22), single, electrical engineer, were appealed for by Mr. A. Dimmack, manager of the Corporation electricity works. He said he could not spare any of them. He had to keep the undertaking going, and it would be impossible to do so if they took these men away. They had to run the electricity works for 24 hours a day and for seven days a week. His proposal was that the Army should provide substitutes who had already been in the electrical trade, and as these men became efficient the others would be released. Mrs. Whitworth said that women were filling these posts in London. Mr. Dimmack stated that in stations where women were employed they would find that there were shift engineers. The Swindon station had never been over-staffed as compared with other stations. They could not leave women in charge of a station by themselves. Mr. Harding said that according to the Government instructions issued to Tribunals the previous week these men were exempted. Mr. Dimmack offered to release Grimes and Lane if substitutes were given.

The cases were adjourned for a month and referred to the Substitution Officer.

Appointments Vacant.—Applications for the post of shift engineer for Reigate should be sent in by Wednesday, December 13th, not *12th*, as incorrectly printed by us in the advertisement of last week.

Boiler house shift engineer (£150), for the City of Birmingham electricity supply department; junior assistant engineer (38s.), and switchboard attendant, for the Borough of Wimbledon electricity department. See our advertisement pages to-day.

Electrochemical Industries for South Africa.—The report of a Committee of the South African Institute of Electrical Engineers (Inc.) on the possibilities of manufacturing in South Africa, by the aid of electrical power, several products of commercial importance which are necessary for the agricultural and mining industries, which was abstracted in our issue of March 24th, may now be consulted by British firms interested at the Offices of the Department of Commercial Intelligence of the Board of Trade.

The Decimal System.—The Holborn Borough Council, on November 22nd, unanimously adopted a resolution that it was not only desirable, but essential, to adopt a decimal system of coinage, weights, and measures throughout the British Isles; to enable our manufacturers and merchants to compete more easily and successfully with rival nations.—*The Times.*

In October a recommendation of the Finance Committee of the Stepney Borough Council, that the Government be urged to take immediate steps to adopt the decimal system, was adopted by the Council, and similar recommendations were made to the Deptford, Hammersmith, Fulham and other Borough Councils.

The Bradford Chamber of Commerce received a letter from the Clayton District Council enclosing a resolution in favour of the adoption of the decimal system, and on October 31st discussed the subject; no resolution was put forward, but several members strongly advocated the adoption of the system on the ground that our present units hindered the development of our foreign trade, some firms abroad declining to do business with British firms unless they adopted the decimal system.

The Council of the Association of Chambers of Commerce will consider at the next meeting the question of the adoption of the metric system of weights and measures and the decimal system of coinage.—*The Times.*

As announced in our last issue, a debate will be held at the Engineers' Club, Manchester, on the evening of Tuesday, December 5th, at 7.30 p.m., on "The Decimal System," at which many members of the recently-formed Manchester and District Decimal Association will be present. The debate will be opened by Mr. Edward C. Barton, M.I.E.E., formerly chief engineer to the Brisbane City Council, Australia, who has made a special study of decimal coinage and the metric system.

Parliamentary.—Wimbledon Corporation seeks powers to supply electricity in the Parish of Cuddington.

Ripon Corporation seeks powers to supply electricity within the City of Ripon and parts of the rural districts of Ripon and Knaresborough.

The Ebbw Vale U.D.C. is applying for a Bill for various powers, including further powers in regard to the supply of electricity.

Blackpool Corporation is applying for powers to supply electricity in certain parts of Carleton and Marton, which it is sought to include within the borough.

Sheffield Corporation seeks powers to appropriate lands for erection of new generating station, construct electric lines, &c.

Ashton-under-Lyne Corporation seeks powers to purchase tramways authorised by the Oldham, Ashton-under-Lyne, Hyde and District Electric Tramways Order of 1896.

The Electrical Distribution of Yorkshire, Ltd., seeks supply powers for Garforth, Featherstone, Luddenden Foot, and Horbury.

The Smithfield Co.'s Employes.—At the City of London Tribunal, on Tuesday, November 28th, the Smithfield Markets Electric Supply, Ltd., appealed on behalf of the following 15 men:—J. Anthony (29), married, wireman's mate; W. H. Allemande, shift engineer (22), single; J. I. Biggam, shift engineer (29), single; E. A. Copelin, driver (26), married; W. H. Harper, shift engineer (34), married; F. H. Tutt, foreman and meter reader (25), single; T. F. Austin, installation and fuse attendant (36), married; T. G. Deller, assistant driver (40), single; H. J. Lazenbury, driver (39), married; P. F. Roberts, shift engineer (27); J. Richardson, wireman's mate (27), married; C. E. J. Stevens, wireman (29), married; E. W. Warren (33), married; S. Hidson (36), married; and A. E. Fyears. Mr. Powell, the secretary of the company, appeared in support of the applications. It will be remembered that when the case was last before the Tribunal, it was stated that there had been a fire on the company's premises, and this had thrown the whole thing into confusion. The station had been wrecked, and the men were appealed for because they were engaged on work of public utility, every man being absolutely necessary for the carrying-on of the business. The claim on behalf of H. J. Lazenbury was now withdrawn, as he had been rejected by the Navy, and that on behalf of Fyears was also withdrawn, as he was now over military age. The Tribunal decided to postpone Anthony, Allemande, Biggam, and Copelin to January 1st, and then serve; Tutt to January 30th, and serve; and Harper, Austin, Deller, Roberts, Richardson, Stevens, Warren, and Hidson to March 8th, with the right to renew. All the postponements were subject to the V.T.C. condition.

Volunteer Notes.—FIRST LONDON ENGINEER VOLUNTEERS.—Headquarters, Chester House, Eccleston Place.—Orders for the week by Lieut.-Col. C. B. Clay, V.D., Commanding.

Monday, December 4th.—Technical for Platoon No. 9, at Regency Street. Squad and Platoon Drill, Platoon No. 10. Signalling Class. Recruits' Drill, 6.25—8. Lecture, "On Telephones," 7.30.

Tuesday, December 5th.—School of Arms, 6—7. Lecture, 7.15, "The Service of Protection," Company Commander Hynam.

Wednesday, December 6th.—Instructional Class, 6.15. Platoon Drill, Platoon No. 2.

Thursday, December 7th.—Platoon Drill, Platoon No. 7. Ambulance Class by M.O., 6.

Friday, December 8th.—Technical for Platoon No. 10, Regency Street. Squad and Platoon Drill, No. 9. Signalling Class. Recruits' Drill, 6.25—8.25. Lecture, "On Telephones," 7.30.

Saturday, December 9th.—Inspection by General Sir Desmond O'Callaghan, at 3, in Hyde Park.

Sunday, December 10th.—Entrenching at Otford. Parade at Victoria (S.E. & C. Railway Booking-office), 8.45 a.m.

Corps Supper.—A Corps Supper will be held at the Queen's Hotel, Leicester Square, on December 8th, at 7.

(By order) MACLEOD YEARSLEY, *Adjutant.*

Institution and Lecture Notes.—University College, London.—Prof. J. A. Fleming commenced his fifth lecture on "Long-Distance Telephony" on Friday last with a demonstration of the effect of loading upon the current sent into a 14-mile 44-lb. cable, and the current received at the far end. Artificial cables were employed, and it was shown that on switching over from an unloaded to a loaded cable, the current at the sending end diminished, but the received current very greatly increased. The high-frequency alternator used for the experiment did not yield a pure sine wave, but Prof. Fleming showed that the undesired components of the wave could be "filtered out" by connecting resonating circuits in shunt to the terminals, each such circuit containing a capacity and an inductance in series, such that the frequency with which it would resonate equalled $1/2\pi\sqrt{LC}$. By winding coils upon the inductance coils, as in a transformer, pure sinusoidal currents corresponding to the resonating harmonics could be obtained, having, for instance, frequencies of 1,000, 3,000, or 5,000 cycles per second respectively. For the study of these high-frequency waves the Duddell oscillograph was not suitable, as its natural frequency of vibration was not sufficiently great—it should be 10 times that of the wave under examination. The Braun kathode-ray oscillograph was free from this objection, but the trace obtained was not sharp enough. However, a rough practical test could be made with a condenser, voltmeter and ammeter; connecting these with the alternator, if no harmonics were present, the current I would be $= 2\pi n VC \times 10^{-6}$, or $10^6 I/n VC = 2\pi = 6{\cdot}28$: if, however, harmonics were present, the latter ratio would always be greater than 6·28, possibly two or three times as great. For a true sine wave it was best to use a special machine, such as that designed by Mr. Duddell.

The measurement of the small alternating currents employed in telephony necessitated the construction of special instruments, usually dependent upon thermal effects. The lecturer described such instruments which he had devised, including one using his oscillation valve. For determining phase difference between current and voltage the Francke machine was described, as well as the Drysdale A.C. potentiometer with phase-shifting device. Methods of measuring small capacities were also explained. Remarking, in connection with the measurement of s/c, that the Post Office engineers had discovered that gutta-percha conducted alternating currents better than direct current, Prof. Fleming described a special capacity bridge which he and his late assistant, Mr. G. B. Dyke (killed on active service), had developed for the investigation of this effect, and showed the importance of the phenomenon in the cases of dry manila paper, gutta-percha, and vulcanised rubber, all of which varied widely in conductivity for high-frequency alternating currents with the frequency and the temperature. For ordinary g.p. s/c = 100 or 120: for Siemens special g.p. s/c = 20 or 12. The value of R/L could be measured with the Hughes bridge, which the lecturer explained in detail.

Smoke Prevention.—Lecturing at the Leeds Luncheon Club on Monday, last week, on "A Smokeless Leeds, with £500,000 a Year Profit," Dr. S. F. Dufton, H.M. Inspector of Schools in the West Riding, said the normal coal consumption in the city in a year, in the gas works, electricity works, and households—but not including the bulk used in factories and workshops—was nearly 850,000 tons. Of this amount 80,000 tons was burnt "raw" in the furnaces at the municipal electricity works, wasting enormous quantities of valuable by-product, in addition to pouring out volumes of harmful smoke. He urged the distillation of all coal before burning it. Everything at the present time combined to make the immediate adoption of the reform practicable, and it would effect a saving throughout the country of a hundred million pounds a year. For the future no gas or electricity profits should go in reduction of rates, but should all be applied to the reduction of capital charges and reduction to consumers of the cost of light and power, the life-blood of industry.

Junior Institution of Engineers.—On Monday, December 11th, Mr. F. W. Lanchester will deliver his presidential address on "Industrial Engineering: Present Position and Post-War Outlook." The Marquis of Graham, the retiring President, will take the chair.

Association of Electrical Station Engineers.—The address of this Association has this week been changed to 26, Little Park Gardens, Enfield.

Society of Engineers.—On Monday, December 11th, two papers will be read on the mineral resources of the United Kingdom and of the Empire, by Prof. W. G. Fearnsides and Prof. C. G. Cullis respectively.

Science and Industry.—At Leicester, recently, Professor G. Kapp gave a lecture on electrical engineering before the Literary and Philosophical Society, one of a course of three lectures on "Science and Industry" that has been organised by the Society. He stated that in England electrical engineering was not lagging behind other nations, and in some respects was ahead of Germany. He had just examined a new process for the manufacture of nitrates from the air, which gave great promise.

Royal Society of Arts.—On Wednesday last Dr. Dugald Clerk read a paper on the internal combustion engine, in which he reviewed the development of this motor, and showed how prominent a part had been played by British inventors.

Sir Charles Parsons drew attention to the universal use of this type of engine for small powers to-day, and the importance of its educational influence upon the public in mechanics and engineering. He mentioned that Dr. Clerk, in the very near future, would assume a very important Governmental position in connection with developments in this country.

"Electricity on the Farm" Campaign.—According to the *Electrical World*, a systematic co-operative campaign to place electricity on every farm in the United States is now being launched by the Western Electric Co. In the past much of the farm business has not been transacted through the central station, contractor, or electrical dealer, and it is emphasised that this is an effort to market equipment through recognised electrical channels. At the outset a big advertising campaign is to be undertaken with 21 farm papers reaching 3½ million subscribers each month; these are intended to bring requests for a "Farmers' Electrical Handbook," thus furnishing a clue to prospective business, which will be notified to the local trade, and if necessary the company will itself endeavour to get the business. The handbook is both a catalogue and working treatise of the subject. The company, while pushing its farm-lighting set, urges preference for central-station service, if available, and the advisability of consulting the nearest lighting authority in any case. The independent lighting set is rated at 32 volts, but only 110-volt fittings, wiring, &c., are supplied, so that the farm can take the central-station service when available, only the 32-volt appliances needing to be replaced.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station and Tramway Officials.—West Ham Corporation has decided that in consideration of the extra responsibility placed upon Mr. HOPKINS, the chief assistant of the tramways, during the change of managers, he be paid a gratuity of £20.

Mr. G. H. DALE, late of London, has been appointed mains assistant at the Dover Corporation electricity works.

General.—The *Commonwealth Engineer* states that Mr. F. GOLDING, formerly assistant electrical engineer in the Commonwealth Postmaster-General's Department, New South Wales, has been appointed electrical engineer for Victoria, in succession to Mr. A. A. Dircks, who has become electrical engineer of New South Wales. Mr. F. FAIRLEY, formerly connected with the electrification scheme of the Victorian railways department, has been appointed senior engineer assistant in connection with the electrical department of the Melbourne City Council. Mr. J. Y. NELSON, formerly electrical engineer for New South Wales in the postal service, was presented with a tea and coffee service and silver salver by the staff on the occasion of his retirement after 49 years of service.

Ald. JAMES HEALD, of the firm of Messrs. Calvert & Heald, electrical engineers, &c., has been re-elected Chairman of the Lancaster Corporation Electricity Committee.

Hammersmith B.C. Electricity Committee has appointed Ald. JOHNSON Chairman, and Coun. CHAMBERLAIN Vice-Chairman, of the Committee for the current municipal year.

Roll of Honour.—Sapper W. HEASMAN, R.E., of Maidenhead, has won the Military Cross. He was on the Reserve when war broke out, in the employ of the Telephone Section of the G.P.O. The award was for special and dangerous work in connection with the laying of telephone cables.

We are pleased to record the conferment of the Victoria Cross upon a former employé of the Western Electric Co., Ltd., Woolwich—Private F. J. EDWARDS, of the Middlesex Regiment, who, at a critical moment when his part of the line was held up by machine-gun fire, all the officers had been put out of action, and retirement was imminent, on his own initiative dashed out alone and knocked out the machine gun with bombs. This gallant act, at the greatest personal risk, saved the situation. He joined the Army shortly after the outbreak of war, and is 21 years of age.

Sergeant W. C. STEVENS, Loyal North Lancashire Regiment, who enlisted early in the war whilst with Messrs. Dick, Kerr & Co., Ltd., of Preston, has been killed in action.

Private ERNEST HALL, Scottish Rifles, who is reported killed, after being missing since July 16th last, was an employé of Messrs. Dick, Kerr & Co., Ltd., Preston.

Private A. CAWTHRA, West Riding Regiment, formerly employed in the Bradford Post Office telephone department, has been killed at the Front.

Sapper ERNEST HOWLETT, Royal Engineers, reported to be missing, was with Messrs. Siemens, of Stafford.

Temporary-Lieutenant F. A. ROBINSON, who was in the electrical department of the India-Rubber Co., Silvertown, has been awarded the Military Cross for having, as a "Tank" officer, displayed great gallantry. After tremendous fighting, his Tank became "ditched," and he and his crew dug for 14 hours under heavy fire until they eventually got the monster out and returned with it to the assembling point. Lieutenant Robinson had previously done fine work of the same character at another point. On that occasion his Tank was hit by a direct shell and damaged, but he got his men out safely and

immediately went into the trenches and worked a machine gun. Lieutenant Robinson joined the Navy in the November following the outbreak of war, entering the R.N.A.S. In 1915 he got his commission in the Machine Gun Corps, and having received the necessary training, he went out with the first of the Tanks to the Front. Lieutenant Robinson is the son of Commander Robinson, R.N.R. (retired), of the Submarine Department of the India-Rubber Co., Silvertown.

Sapper JAMES WALKER, R.E., has been killed in action, aged 27. He was employed as an electrical engineer in Glasgow.

Private EDGAR NICHOLLS, East Yorkshires, who has been killed in action, was formerly employed at the Leeds Corporation electricity works, Whitehall Road.

Lieutenant T. J. WEBSTER, formerly third class clerk in the electricity department in Willesden U.D.C., has been killed in action. Private B. YOUNG, formerly a meter reader, is reported missing.

Private ALBERT BIRD, Middlesex Regiment, attached to Queen Victoria's Rifles, who has fallen in action, was an electrician, and prior to the war assisted his father, Mr. A. E. Bird, Hampton, in his business.

Sergeant J. W. FISHER, R.F.A., awarded the Military Medal, was employed by the British Electric Plant Co., of Alloa.

Second-Lieutenant THOMAS FORBES WHIMSTER, R.E., reported killed, was 35 years of age. He was head of the testing department of the Victoria Falls Electric Power Co., Germiston, near Johannesburg.

Private ALEC MARSHALL, Canadian Highlanders (Vancouver), who has fallen in action, belonged to Berwick-on-Tweed, and was on the staff of the British Columbia Electric Co., at Vancouver.

Captain H. S. LAVERACK, of the Coldstream Guards, an electrical engineer, has been wounded.

Private WALTER JACKSON, of the Loyal North Lancashires, reported killed in action, aged 38, was employed at the electrical works, Preston.

The Military Medal for gallant conduct in action has been awarded to Sergeant W. BLACK, 60th Light Infantry Brigade, Headquarters Staff, who was before the war on the staff of the British Thomson-Houston Co. Ltd., at Rugby.

Obituary.—SIR HIRAM MAXIM.—We regret to record that Sir Hiram S. Maxim passed away on November 24th, at his residence in London, aged 76 years. Sir Hiram's world fame rested chiefly upon the machine gun, which made his name a household word everywhere, and upon his association with the famous concern, Vickers, Son & Maxim, of which he was a director for 27 years; but he was also one of the earliest inventors in the electric lighting field, as can be seen from articles published in the pages of this REVIEW 35 years ago. Sir Hiram, who was born in the United States, came to England, and made his home here, in 1881. His arc lamp is described in the *Telegraphic Journal and Electrical Review* for April 15th of that year. A demonstration of his incandescent carbon filament lamp, using current from a dynamo-electric machine of his own design, was given in the following May at the Albany Works, in Euston Road, and reported in our issue of June 15th, 1881. His very fertile brain, with its wonderful inventive ingenuity, led him to carry his activities into many other branches of scientific research and practical engineering application. The gas engine, metallurgy, woodturning, and, in recent years, aeronautics, of course, attracted him, and with good results. Latterly, like many another, he had taken great interest in the finding of means for dealing scientifically with the Zeppelin menace. He was knighted in 1901.

SIR GEORGE WHITE.—We regret to record the death of Sir George White, which occurred suddenly last week at Bristol. Sir George, who was 62 years of age, began life in humble circumstances. In 1874 he was appointed secretary of the company which opened the first tramway line in Bristol, but his interests were transferred to stockbroking, and subsequently to railway enterprises until 1893, when, in conjunction with his brother and the late Sir Clifton Robinson, he secured the control of and developed the systems of the Imperial, Dublin, and Middlesbrough tramway companies, which were electrified on the trolley system and extended. The interest of the group in the London United Tramways followed. With the boldness and enterprise which had characterised his earlier ventures, Sir George took an interest in aviation, and this interest took a very practical shape in the establishment of the first aeroplane factory in England. He was made a baronet in 1904. He was a generous benefactor to local infirmary and other similar institutions.

MR. R. F. MANN.—The *Daily Telegraph* records the death of Mr. R. F. Mann, of Harrow, an X-ray operator at the Middlesex Hospital for the last 17 years. Mr. Mann was the first X-ray operator at the institution, and he was working at a time before modern safety appliances were in use. Although he was medically advised to give up his work four years ago he refused to do so. Since the outbreak of war the demand on his knowledge and skill had been so great that it hastened his end, for in addition to his position at the Middlesex Hospital he undertook the work of radiographing wounded soldiers at the Clacton Branch, and for the Duchess of Bedford's Military Hospital at Woburn. Notwithstanding the fact that within twelve months he had undergone four serious operations, he remained at his post until last July, when another operation ended his activities, and after manfully enduring the pains of X-ray dermatitis, he has died in his 36th year.

MR. H. TODHUNTER.—The death is notified of Mr. Hugh Todhunter, J.P., for many years partner in the firm of Messrs. Todhunter & Elliot, Ltd., electricians, Douglas, Isle of Man.

NEW COMPANIES REGISTERED.

Tyne Electric Steel Foundries, Ltd. (145,350).—This company was registered on November 20th, with a capital of £39,750 in 35,000 pref. shares of £1 each and 95,000 ord. shares of 1s. each, to take over the business of the Electro-Flex Steel Co., Ltd. (incorporated in 1911), to acquire any patents and inventions relating to electric furnaces and the electrical smelting of ores and refining of metals, or to electric batteries or electrochemical or electrothermal processes, &c., and to adopt an agreement between W. Swan and R. P. Sloan. The subscribers are: F. S. Newall, Castle Hill, Wylam, chemical manufacturer, 200 pref.; R. P. Sloan, Royal Exchange Buildings, Newcastle-on-Tyne, electrical engineer, 200 pref.; W. H. McAlpine, Clydebank, contractor, 200 pref.; A. D. C. Parsons, Hindley House, Stocksfield S.O., engineer, 200 pref.; R. E. E. Spencer, Walbottle Hall, Newburn, engineer, 200 pref.; H. A. Couves, Royal Exchange Buildings, Newcastle-on-Tyne, engineer, 1 ord.; M. Short, Royal Exchange Buildings, Newcastle-on-Tyne, company secretary, 1 ord. Minimum cash subscription, £100. The first directors (to number not less than two or more than seven) are: F. S. Newall, R. P. Sloan, W. H. McAlpine, A. D. C. Parsons, and R. E. E. Spencer. Qualification, £200. Remuneration as fixed by the company. Solicitors: Watson, Burdon & Corder, Pilgrim House, Newcastle-on-Tyne. Registered office: Dunston-on-Tyne, Durham.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Weaverham Electricity Supply Co., Ltd.—Particulars of £2,000 debenture stock, created by resolutions of February 19th, 1915, and October 26th, 1916, and secured by trust deed dated November 2nd, 1916, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's undertaking and property, present and future, and power station, plant, and machinery in Weaverham, Ches. Trustees: W. H. Burgess, Rose Cottage, and G. H. Dean, Beech Hill, both in Weaverham.

Farad Electrical Co., Ltd.—Debenture dated October 11th, 1916, to secure £150, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: Mrs. F. Whitehead, 5, Warwick Road, Worthing.

Brecknell, Munro & Rogers, Ltd.—A memorandum of satisfaction in full on June 29th, 1916, of debentures dated August 9th, 1915, securing £2,500, has been filed.

India-Rubber, Gutta-Percha & Telegraph Works Co., Ltd.—A memorandum of satisfaction in full on or before August 10th, 1916, of debentures dated March 27th, 1906, securing £400,000, has been filed.

James Keith & Blackman Co., Ltd.—A memorandum of satisfaction in full on November 11th, 1916, of debentures dated January 6th and December 8th, 1903, and September 24th and November 13th, 1913, securing £1,350, has been filed.

Ferguson, Pailin & Co., Ltd.—Mortgage or charge by resolution of November 14th, 1916, relating to deposit of deeds, charged on property in Edward Street, Higher Openshaw, Manchester, to secure all moneys due or to become due from company to Williams Deacon Bank, Ltd., Mosley Street, Manchester.

Baxendale Bros., Ltd.—Second debenture, dated November 3rd, 1916, to secure £945, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: W. I. Baxendale, 5, Lingdale Road, West Kirby, Ches.

Pritchett & Gold and Electrical Power Storage Co., Ltd.—Issue on November 14th, 1916, of £10,000 debentures, part of a series of which particulars have already been filed.

Glantawe Electric Supply Co., Ltd. (112,615).—Capital, £15,000 in £10 shares. Return dated June 9th, 1916. All shares taken up; £15,000 paid. Mortgages and charges: Nil.

H. T. Boothroyd, Ltd. (99,742).—Capital, £16,000 in 11,000 ord. and 5,000 pref. shares of £1 each. Return dated Oct. 2nd, 1916. 10,002 ord. and 2,809 pref. shares taken up; £2,802 paid on 2 ord. and 2,800 pref.; 10,000 considered as paid on 10,000 ord. Mortgages and charges: £4,791.

Halifax & Bermudas Cable Co., Ltd. (28,972).—Capital, £50,000 in £5 shares. Return dated October 5th, 1916. All shares taken up; £50,000 considered as paid. Mortgages and charges: Nil.

New Liverpool Rubber Co., Ltd. (109,933).—Capital, £150,000 in 98,000 ord. and 52,000 pref. shares of £1 each. Return dated November 3rd, 1916. 58,502 ord. and 51,410 pref. shares taken up; £58,502 paid on the ord.; £5,410 considered as paid on the pref. Mortgages and charges: £25,705.

Whitchurch and Pangbourne Electric Supply Co., Ltd. (75,400).—Capital, £10,000 in 1,700 ord. and 300 pref. shares of £5 each. Return dated October 12th, 1916. 1,006 ord. shares taken up; £5,030 paid. Mortgages and charges: Nil.

CITY NOTES.

Edison Swan Electric Co., Ltd. The annual meeting was held on November 22nd at the offices, 123-125, Queen Victoria Street, E.C. Mr. C. J. FORD, who presided, said that the figures in the balance sheet ran into much larger amounts than last year, and he believed that the turnover had never been on such an extensive scale since the company started business. Sundry creditors and credit balances had increased from £80,000 to £125,000. Stocks showed an increase of from £211,000 to £272,000, and amounts due from sundry debtors from £89,000 to £103,000. They had expended about £16,000 on buildings, plant, and machinery, and after providing for depreciation at the usual rates the net increase under those headings amounted to £7,293. The net profit on trading account had increased from £56,000 to £65,000, whilst the general

expenses showed a reduction of £2,700. The profit earned for the period had been increased from £14,000 to £24,000, which he trusted they would consider under all the circumstances satisfactory. The engineering side of the works had been almost wholly employed upon Government work at moderately remunerative prices. The lamp side of the works had been fully employed so far as restricted labour conditions had permitted, and the sale of lamps had been largely increased. It was pointed out last year that the prices of lamps had remained the same as they were previous to the war, and had it not been for the increased cost of labour and raw materials, which might be safely put at between 30 and 40 per cent., the company had done very well indeed in this department, and the profits would have shown a still further improvement. It was only necessary to study the balance sheet a little in order to become aware of the fact that the company was urgently in need of further capital. He had referred to that question at previous meetings, but as the trade increased that shortage of capital naturally became more acute, and the time had now arrived when the board felt that the most serious effort must be made to provide further funds. For this reason, it was much to be regretted that it had been impossible to recommend the payment of a dividend, as, although there was a profit of £24,000, they had had to employ £16,000 of it in additional plant and machinery to cope with the increased business. If, on the other hand, they had further adequate working capital, it would no doubt be possible to distribute a proper portion to the shareholders in the shape of dividends. For that reason they recommended the transference to reserve of £25,000, bringing that up to £40,000, and carrying forward £4,025. The board had been very seriously considering the question of further capital, and had taken an opportunity of consulting some of the largest share and debenture stockholders with reference thereto. They were, of course, aware that there was a sum of £2 per share uncalled upon 99,000 ordinary shares, and the usual course for a company with that amount of uncalled capital would be to call up the necessary amount required. That, however, was denied to them, as the amount in question was pledged to the debenture stockholders as part of their security, and could not be called up without their consent. Undoubtedly that uncalled liability had a very prejudicial effect upon the price of the shares, as otherwise there was, to his mind, no reason whatever why, with the improved prospects of the company and its profit-earning capabilities, they should not stand at a higher price, and that reflected itself in great measure undoubtedly upon the price in the market of the debenture stocks. The board were in a difficult position, standing as they did between the debenture stockholders and the shareholders, who had divergent interests, and any scheme for the raising of further capital had to be framed to meet the views of both parties, which was not easy. However, amongst many suggestions, a scheme had been discussed with leading representatives of both those interests, and he was pleased to be able to inform them that there was now a fair chance of arriving at a solution of the difficulty, and, although he could not pledge himself that it would finally assume the exact form he was about to refer to, he trusted they would be able to achieve something on the following lines: That £100,000 7 per cent. preference shares be issued, participating in further profits up to a further 3 per cent. after the ordinary shareholders had received a dividend, the rate of which had not yet been decided upon. The board felt that in any scheme for the provision of further capital, strenuous endeavours should be made to deal with the liability upon the ordinary shares, and it had been proposed that this should be met in the following way:—They to offer to the existing shareholders the right to subscribe for £1 of preference shares in respect of each ordinary share held by them, and if they accepted that offer the debenture stockholders would be asked simultaneously to agree to the cancellation of the £2 liability in respect of such shares held by those parties who availed themselves of the option; shareholders who did not so avail themselves of this option would be left as they were to-day, with the liability. In effect, it amounted to this, that for the payment of £1 per share, for which a shareholder would receive a participating preference share, he would wipe out the other £1 of liability, and it was thought that a large number of shareholders would avail themselves of that opportunity. As a recompense to the debenture stockholders for this concession, it was suggested that the two classes of debenture stocks should be amalgamated into one class, and that the interest thereon be fixed all round at 5 per cent. per annum; to-day the first debenture stock, amounting to £307,000, bore interest at 4 per cent., and the second debenture stock, amounting to £67,000, at 5 per cent. That would throw an additional burden by way of interest upon the company amounting to £3,000 per annum, but, under the circumstances, he thought it was entirely warranted. Further, it was suggested that after the payment of the preference dividend up to 7 per cent., a percentage of the available profits remaining should go to a sinking fund for redemption of debenture stock, and the balance would be therefore available for dividend upon the ordinary shares. In the opinion of the board, apart from the profits which the proposed new capital should earn, the additional money would enable the company to enter into far more advantageous contracts for the purchase of raw materials and other goods than had been possible for some time past, which naturally would go to increase the profits. Those were the general lines of the scheme which they had been considering, and he was hopeful that they would be able to carry it, and if the consent of the debenture stockholders could be obtained, he thought they would agree that it was obviously in the interests of the shareholders to support it. They had come to this position in the affairs of the company, that unless means could be found to enable them to go forward, they must inevitably go backward, and he was hopeful that after the cessation of hostilities restrictions would be put upon the free import into this country of electrical goods at the ruinous cut-prices which had hitherto prevailed, and that, with adequate working capital, they would be able to do a largely increased profitable business, particularly on the export side. To-day they could, had they the money, largely increase the sales in Australia, South Africa, and India. They had during the past two years greatly extended their operations in those countries, and were building up a good business there, and it was there they were looking to the employment of part of the additional capital they were endeavouring to obtain. There was one other point to which he desired to refer, and that was with regard to the denomination of the present £5 shares. A £5 share to-day was somewhat unwieldy, and it had been suggested to the board by members of the Stock Exchange that if they were split into shares of £1 each, they would be far more marketable, and with this he (the chairman) entirely agreed, and the board were proposing to deal with this matter. Of course, the partly-paid £5 shares, that was, any shares upon which the liability was not cancelled in the manner he had before referred to, should their scheme go through, would be 12s. paid, with a liability of 8s. thereon.

Mr. Ellice-Clarke seconded the motion.

Mr. Rayment said that as an old shareholder, who in the past had frequently criticised the policy of the board, he would like to express his hearty congratulations to the present chairman on the very marked improvement in the company's position. He thought Mr. Ford had more than warranted the confidence of the shareholders, and they were very fortunate in having him at the head of their affairs. As shareholders, however, they were keenly disappointed that it had again been necessary to allocate all the profits to reserve. He did not question the wisdom or the necessity of that course, but when it was remembered that since 1906 nearly £96,000 of profit had been dealt with in that way it made one think that there was not even a remote chance of the ordinary shareholders ever getting a dividend.

The Chairman, in reply, said that the object of the scheme which he had outlined for obtaining further capital was in order that the profits in future might be divided among the shareholders. It would not be possible to put the profits to reserve and ear-mark them because the debenture holders had got a charge upon the whole of the assets. When he became chairman they had a so-called reserve fund of £40,000, which had been created by showing profits in the past which really never existed; and the whole of that had been written off. They must only look at the reserve which they had really created since then, which to-day stood at £40,000.

The report was then adopted.

Société Francaise des Câbles Télégraphiques.

The report of the directors states that notwithstanding the increase in the receipts in the trans-Atlantic service in 1914, the results obtained in 1915 exceeded those in the previous year by 5 per cent., despite the absence of normal conditions in the lines, especially in the first half of the year. Several ruptures took place in the trans-Atlantic cables, and the interruption was simultaneous on both conductors for several weeks owing to the difficulty of carrying out repairs, particularly those of breakages localised at depths of 4,700 metres, which had to be postponed until fine weather prevailed. On the other hand, the company had assured the transmission free of charge of the official telegrams of the French and United States Governments, without, however, raising the rates for the paying traffic. In the case of the network in the West Indies the receipts experienced a growth of 28 per cent. over 1914, and the revenue in the republic of Dominica was also considerably higher. The land lines in the latter republic suffered less from interruptions than in 1914 in harmony with the less troubled political situation in that country, whilst the new cable laid between St. Domingo and Porto Rico assured communication between the capital and other countries. Since the establishment of the latter cable, which had permitted of the opening of a new route between St. Domingo and Puerto Plata *vid* Porto Rico, the company's difficulties in Venezuela had ceased, and the situation there had become regular. The working of the cable between Australia and New Caledonia was normal throughout the year, and the receipts increased as compared with 1914, when the cable was interrupted for three months and a half. The subsidies and guarantees received amounted to £25,800, as compared with £25,000 in the preceding year. In 1914 the States of Queensland and New South Wales reduced their subsidy in consequence of the cable between Australia and New Caledonia having been interrupted for a period exceeding 30 days, which was the term fixed by agreement as the maximum duration of any stoppage. Since then, however, and thanks to the intervention of the French Government, those States had admitted that the delay in effecting the repairs was due

to a case of *force majeure*, and had agreed to pay that part of the subsidy which had been withheld. The subsidy of Dutch Guyana continued to be paid, whilst the litigation concerning the subsidies of French Guyana, the Martinique, and the Guadeloupe was now being settled with the Minister for the Colonies. The accounts show net profits amounting to £134,000, and a dividend at the rate of 4 per cent., or 8s. per share, has been declared on the ordinary capital of £537,000, being the same rate as in 1914. It has also been possible to apply £71,000 towards the reduction of interest guarantees on advances made by the Government, which totalled £136,000 at the end of 1914.

Allgemeine Elektricitats Gesellschaft.

The report of the directors for 1915-16 states that the increase in the share capital which was sanctioned in September, 1915, had been carried out, and the ordinary capital been advanced by £1,450,000 to £9,200,000 by the exchange of new shares of £1,303,750 for shares of £1,738,000 in the Berlin Electricity Works Co., whilst the balance of £146,250 was subscribed in cash, the premium realised having partly served to defray the cost of the issue. The company also in the past year placed its plant, which had been adapted to war purposes, at disposal to a considerable extent for armament works, although the situation still prevented any details from being announced. Nevertheless, the provisional transformation of the production had rendered its necessary already in 1915-16 to take into account the extraordinary expenditure, which was required for the resumption of peace manufactures and fresh competition. As a consequence, the valuation of the plant and stocks, and of property abroad, whether securities, investments, or credit, had been so entered that disadvantages could scarcely arise therefrom. The business in manufactures for peace purposes, although frequently hindered through Government commandeering, had received a new impetus in connection with the war requirements, large orders having been booked specially for the heavy industries. The branch for private installations and connections was active and profitable, but was rendered difficult owing to the lack of labour. The turnover in glow lamps, meters, and heating apparatus at home and abroad exceeded that which obtained in the previous year. Zinc and aluminium windings were introduced for machines and transformers, and suitable substitutes were provided for copper and rubber in the case of insulated wires. The accounts for the past three years show the following figures:—

	1913-14.	1914-15.	1915-16.
Ordinary share capital ...	£7,750,000	£7,750,000	£9,200,000
Loans	—	5,364,000	5,320,000
Gross profits	1,132,000	1,544,000	1,987,000
General expenses... ...	73,000	72,000	91,000
War grants to employés...	—	230,000	377,000
Depreciation	44,000	44,000	45,000
Net profits and balance forward...	944,000	1,064,000	1,359,000
Bonuses	60,000	75,000	100,000
Pension fund	50,000	75,000	100,000
War benevolence... ...	—	—	75,000
Dividend	775,000	852,500	1,017,000
,, per cent. ...	10	11	12

The report proceeds to state that the central station department was able to hand over in working order the Zschornewitz power station to the Elektro Works Co. last December, whilst an extension order was received for four turbo-dynamos each of 22,500 KW., together with boilers and other equipment, for the supply of power to the Elektro-Nitrum Co. An order for a turbo-dynamo of 20,000 KW. and converters of 1,800 and 1,500 KW. was booked for the City of Berlin, and one for a turbo-generator of 21,000 KW. for the Silesian Electricity Co. In addition, a contract was obtained from the Rhenish-Westphalian Electricity Works Co. for two complete steam turbine sets and condensers, each for an output of 50,000 KW., as well as for a generator for 60,000 KW., and two transformers for a pressure of 100,000 volts and an output of 65,000 KW., and two turbo-generators and condensers each of 14,000 KW. It is submitted that these orders are of special importance because they indicate that the war has not arrested the further development of the industry on the one hand, and, on the other, that the erection of power stations has been placed on a new footing. Dealing with the railway department, the report mentions that the works for the A.E.G. high-speed railway were advanced, and the tunnel under the Spree was approaching completion. The electricity works closely associated with the company yielded in general better results than in 1914-15; the works at Jassy had been under compulsory management since the declaration of war on Roumania. In the case of the Berlin Electricity Works Co., whose Berlin undertaking was acquired by the Municipal Council in October, 1915, the chief scope of activity was now devoted to the development of the company's other works, including those in the lignite districts of Bitterfeld, where, however, working and production were unfavourably influenced by the conditions of the times.

The accounts purport to show that the credit at the bankers, which totalled £4,531,000 in 1914-15, now amounts to £6,785,000, and the investments are entered at £2,819,000, as compared with £2,843,000 in the previous year; whilst the reserve fund remains at £3,678,000, without any change.

West India and Panama Telegraph Co., Ltd.

Sir A. F. King presided, on November 15th, at the annual meeting. He said that the cost of repairs to cables was £7,633 in excess of that for the half-year to June, 1915, over £2,300 of the increase being due to new cable being used in repairs, which was not, in itself, a matter for much regret because the system was strengthened to that extent. No opportunity occurred for letting out their repairing ship during the half-year. The profit for the half-year showed an increase of £2,349 over the corresponding half of 1915, and they were able to resume paying a dividend on the ordinary shares. The traffic receipts, so far, during the current half-year compared favourably with those for the December period of last year. The hurricane season in the West Indies, which usually commenced in August, was of special severity this year. In that month Jamaica suffered seriously. Their landlines were blown down in many places, but communications were restored in two or three days. In Dominica telegraphic communication was cut off for several hours, but for the company the most disastrous of the hurricanes struck St. Thomas and the adjacent island of St. Croix, on October 9th, causing great damage in both islands. Their small house and shed at Krum Bay, St. Thomas, were totally destroyed, and their wharf was damaged. The mortgage debentures issued 25 years ago would fall due for payment on December 31st. The issue was only a small one—namely, £80,000—the share capital being £1,275,000. It was their intention shortly to issue a circular inviting the present holders to renew them for a period of ten years. The debentures were a first charge as a floating security upon the whole of the company's property. They would be renewed at the same rate of interest—namely, 5 per cent. per annum—but, in view of the state of the money market, it was felt that the present holders might not be eager to renew them at par, at which price they were issued, and that some inducement in the form of a cash payment must be offered for their renewal. Coupons for a half-year's interest, payable on June 30th and December 31st in each year, would be attached to each bond, and the bonds would be redeemable at the company's option upon six months' notice at £105 per bond. Should all the bonds not be renewed, some would be available not only for any present holders who might wish to increase their holdings, but also for shareholders.

Castner-Kellner Alkali Co., Ltd.

The directors do not feel justified in submitting any accounts for the year to September 30th, owing to the fact that they are not able to estimate the liability for excess profits tax. The amount payable for the previous financial year has not been settled. The profits have exceeded those of the previous year, and the business, though carried on under considerable difficulties, is proceeding satisfactorily. As soon as the amount payable for excess profits has been ascertained the directors will submit the accounts. The auditors have expressed their opinion that the profits are sufficient to warrant the directors recommending that a final dividend of 13 per cent. be declared, which, with the interim dividend of of 9 per cent. paid in May, makes 22 per cent. for the year.

East India Tramways Co., Ltd.—The gross receipts for the year ended July last were £27,104, and the working expenses £19,408; net receipts, £7,696. Five per cent. dividend is to be paid on the cumulative preference and ordinary shares, of which an interim dividend of 2½ per cent. was paid May 31st, £2,045; 10 per cent. on the deferred shares, of which 2½ per cent. was paid May 31st, £5,000.

Venezuela Telephone & Electrical Appliances Co., Ltd.—The report for the year ended June 30th shows a profit, including £11,821 brought forward, of £30,076, against £20,401. After providing for debenture interest, &c., and £2,399 for excess profits duty for the past two years, the directors propose to pay a dividend of 30 per cent. on the preference shares (thus discharging arrears to September 30th, 1910), to place £6,000 to reserve for renewals and depreciation, and to carry forward £11,223.—*Financial Times.*

Calcutta Electric Supply Corporation, Ltd.—The number of units sold to consumers during the five weeks ended September 29th, 1916, were 2,699,816, compared with 2,612,755 in the corresponding five weeks of 1915; and during the four weeks ended October 27th, 1916, 2,038,767, compared with 1,889,945 units.

France.—La Société Francaise de Métallurgie Electrique (Procédés Bourgeot) is the name of a new undertaking which has lately been formed in Paris (106, Boulevard Haussmann), with a capital of £24,000.

British Electric Traction Co., Ltd.—The directors have declared the dividend on the 6 per cent. cumulative participating preference stock for the half-year ended September 30th.

Canadian General Electric Co., Ltd.—Quarterly dividend of 2½ per cent. for the three months ending 31st proximo, making 8 per cent. for the year on the common stock.

Shawinigan Water & Power Co.—Dividend, 1¾ per cent. for the quarter to December 31st on the common shares.

STOCKS AND SHARES.

TUESDAY EVENING.

THE condition of Stock Exchange markets is governed almost exclusively for the time being by the state of affairs in Roumania. Business here is checked, caution has taken the place of confidence, and everybody—investor and speculator alike—elects to adopt a waiting policy pending something more definite and favourable from Bucharest. Anticipation has been general that there would be good news this week. The City has been full of vague hints that such might be confidently expected. By the bag of two Zeppelins on Tuesday morning, men's spirits turned bullish again, and the "raid" into London aroused surprise more than any other feeling.

Prices are mostly dull. There is not much selling; prices have drooped by anticipation. In the foreign division, Mexican issues continue acutely flat. The only market to show any animation and resistance to the general feeling of uncertainty has been that for miscellaneous industrial shares, of which Edison & Swan and British Aluminium ordinary stand out conspicuously.

The Home Railway group is dull and heavy. Talk of Labour unrest in the coal districts has chilled any inclination to take an interest in Home Rails on the strength of the stocks' carrying five months' dividends. The Underground group is the firmest, but here, both Districts and Metropolitans have gone back substantially, and the buoyancy of Underground Electric Railways of London issues has given way to lower prices as people came in to take their profits.

Nothing fresh is known as to the possibility of fares being raised on the Underground and London General Omnibus systems. The shilling shares have eased off to 6s. 3d., and at £2 the £10 shares show a loss of 2s. 6d. out of the 6s. 3d. that they gained in the previous week. The income bonds remain tolerably steady at 91. Steam stocks have weakened.

The United States are threatened with Labour troubles of their own, but, notwithstanding this, prices of the American and Canadian industrials are mostly better on the week. Canadian Generals continue to improve. The company has declared a final dividend of 2¾ per cent., making 8 per cent. for the year. Consolidated Gas, Electric & Power of Baltimore went up 3 points to 133. The shares of steel companies have been breaking new high records.

Mexican industrials, however, remain very flat, although there has been no such repetition of slump as occurred last week, when Mexican Light preferred, for instance, shed 8½ points in a single day. As one of the jobbers in the market observed, this sort of thing could not go on for long, for obvious reasons. British Columbia Electric stocks are steadier, and Brazilian Tractions, after dipping to 49½, recovered to 51, still showing a fall of 1½ on the week.

The Argentine Railway market has been infected with acute depression, which has found indirect reflection in the bonds of the country and in the shares of its industrial concerns. Rather curiously, the 4½ per cent. debenture stock of the Anglo-Argentine Tramways Co. is quoted at 74, while the 5 per cent. debenture stock stands 7 points lower. Of course, the security of the former is decidedly better than that of the latter. There is £1,710,000 of the 4½ per cent. stock and six million pounds of the Fives. At the outbreak of war the respective prices were 98½ and 96. In favour of the 4½ per cent. issue, it ought to be added that the dividend on the company's second preference shares (due last July) was postponed. The Shawinigan Water & Power Co. has declared its regular quarterly dividend of 1¾ per cent. on the common shares, the price of which keeps steady at 140. Victoria Falls preference are a firm spot at 21s. 6d., the 5 per cent. second debentures being 102 and the ordinary shares 11s.

The British Electric Traction Co. has declared a dividend of 6 per cent. on its cumulative participating preference stock for the year ended September 30th last, and the price is a little better at 77½. The ordinary stock, which last June received a dividend of £3 in respect of the previous year, stands at 35; while the debenture stocks are quoted 81 and 69 for the 5 per cent. and the 4½ per cent. second debenture respectively. London & Suburban Traction preference are a little better at 8s. 3d., the ordinary shares being quoted about half-a-crown. The 4½ per cent. first debenture stock changed hands the other day at 66. London United Tramways 4 per cent. debenture stands about 48.

The Telegraph and Telephone list is very steady. Great Northern Telegraphs are 10s. better, but Western Telegraphs are ½ down at 11⅛. The speculation in West India & Panama ordinary turned out to be somewhat of the one-day order, and the shares are 1/16 lower at 22s. 6d. Beyond these movements, the list shows a good deal of firmness. Marconis reacted a trifle, though the market is not by any means a bad one. Americans have eased off to 16s. 6d.; Canadians remain about 7s. 6d.

Illumination shares—both electric and gas—continue to be heavy. City of London Electric ordinary slipped back to 11⅝. Metropolitan preference at 3½ are ¼ down. Buyers require to be tempted with cheap prices to induce them to take shares; and the next batch of dividends is awaited, as we have previously observed, with a certain amount of anxiety. The companies are suffering not only from restriction of lighting, but also from the complaint common to most industries nowadays, to wit, shortage of labour, both as regards the outdoor and the indoor staffs.

Edison & Swan shares have been up to 10s. as a result of the meeting last week. The chairman, Mr. C. J. Ford, dwelt upon the improved results which the company has been able to secure during the past financial year, and indicated that the outlook was distinctly bright. He went into an arrangement for the provision of more money, which would enable the company to take better advantage of the business offered to it. On the speech, the shares rose from 7s. 6d. to 10s., but subsequently eased off to 8s. 9d., leaving them with a rise of 1s 3d. on the week. The fully-paid shares remain at 1¼.

British Aluminium ordinary are another good spot at 30s. The rise is no more than a few pence, but there is noticeable activity in the market; and if general conditions were more favourable, the price would probably stand higher. The Castner-Kellner Co. has declared a balance dividend of 13 per cent., making 22 per cent. for the year—an increase of 2 per cent. as compared with the previous 12 months, and the best performance since three years ago. The company pays £32,000 on the quarter of a million shares allotted six months ago to Brunner, Mond & Co., and receives £25,000 in exchange. This, however, is likely to be rectified when Brunner, Mond's final dividend for the year is declared. No change has occurred in Castners. Babcock & Wilcox are steady at 2 15/16, although the market for iron and steel shares has developed a certain amount of irregularity—natural enough in view of the progressive character of the movements that have been taking place lately.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1914.	Dividend 1915.	Price Nov. 28, 1916.	Rise or fall this week.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	10	10	6⅝	—	£7 11 0
Charing Cross Ordinary	5	5	3⅞	—	7 8 2
do. do. do. 4½ Pref.	4½	4½	3 7/16	—	6 11 0
Chelsea	5	4	3	—	6 13 4
City of London	9	8	11⅝	— ⅛	6 17 8
do. do. 6 per cent. Pref.	6	6	10	—	6 0 0
County of London	7	7	10½	—	6 13 4
do. 6 per cent. Pref.	6	6	10	—	6 0 0
Kensington Ordinary	9	7	6⅝	—	6 4 6
London Electric	4	3	1⅝	—	6 10 5
do. do. 6 per cent. Pref.	6	6	4 7/16	—	6 15 4
Metropolitan	3½	3	2⅝	—	6 6 4
do. 4½ per cent. Pref.	4½	4½	3½	— ⅛	7 4 0
St. James' and Pall Mall	10	8	6½	—	6 8 0
South London	5	5	3 11/16	—	6 16 1
South Metropolitan Pref.	7	7	1 15/16	—	6 7 8
Westminster Ordinary	9	7	6 3/16	—	6 13 0
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	95½	—	6 5 8
do. Def.	80/-	33/6	23½	—	7 10 3
Chile Telephone	8	8	7⅞	—	5 12 3
Cuba Sub. Ord.	5	5	3½	—	6 8 6
Eastern Extension	7	8	13⅝	—	*5 15 6
Eastern Tel. Ord.	7	8	142½	—	*5 12 1
Globe Tel. and T. Ord.	6	7	12¼	—	*5 12 0
do. Pref.	6	6	10½	—	5 17 1
Great Northern Tel.	22	22	38	+ ½	5 16 4
Indo-European	13	13	51	—	6 7 8
Marconi	10	10	9⅞	— 1/16	3 9 6
New York Tel. 4½	4½	4½	98	—	4 10 0
Oriental Telephone Ord.	10	10	2 5/16	—	4 6 6
United R. Plate Tel.	8	8	6¼	—	*5 16 5
West India and Pan.	1	—	1⅛	— 1/16	—
Western Telegraph	7	8	14⅜	— ½	*5 11 4
HOME RAILS.					
Central London, Ord. Assented	4	4	65½	—	6 2 2
Metropolitan	1½	1	21	— ¼	4 3 4
do. District	Nil	Nil	16	— ⅛	Nil
Underground Electric Ordinary	Nil	Nil	2	— ⅛	Nil
do. do. "A"	Nil	Nil	6 3	—5d.	Nil
do. do. Income	6	6	91	— ½	*6 11 10
FOREIGN TRAMS, &C.					
Adelaide Sup. 6 per cent. Pref.	6	6	4 13/16	—	6 1 6
Anglo-Arg. Trams, First Pref.	5½	5½	3⅛	—	8 9 2
do. 2nd Pref.	5½	5½	2⅝	—	—
do. 5 Deb.	5	5	67	—1	7 9 3
Brazil Tractions	4	4	51	—1½	7 16 10
Bombay Electric Pref.	6	6	10½	—	5 17 3
British Columbia Elec. Rly. Pfce.	5	5	69	—	7 5 0
do. do. Preferred	—	Nil	49	—	Nil
do. do. Deferred	—	Nil	47	—	Nil
do. do. Deb.	4½	4½	62	+1	6 17 4
Mexico Trams 5 per cent. Bonds	—	Nil	33½	—	Nil
do. 6 per cent. Bonds	—	Nil	27½	—	Nil
Mexican Light Common	Nil	Nil	12½	—	Nil
do. Pref.	Nil	Nil	22½	—	Nil
do. 1st Bonds	Nil	Nil	32½	—	—
MANUFACTURING COMPANIES.					
Babcock & Wilcox	14	15	2 15/16	—	5 2 0
British Aluminium Ord.	5	7	30/-	+3d.	5 6 8
British Insulated Ord.	15	17½	11⅝	—	7 5 10
British Westinghouse Prefs	7½	7½	2 7/16	—	6 3 0
Callenders	15	20	12⅝	—	7 15 4
do. 5 Pref.	5	5	4½	—	5 17 8
Castner-Kellner	20	22	8½	—	5 6 8
Edison & Swan, £3 paid	Nil	—	1 5/16	+ 1/16	Nil
do. do. fully paid	Nil	—	1¼	—	Nil
do. do. 4 per cent. Deb.	5	5	62½	—	8 0 0
Electric Construction	6	7½	1⅛	—	6 13 4
Gen. Elec. Pref.	6	6	10	—	6 0 0
do. Ord.	10	10	14	—	7 2 10
Henley	20	25	16	—	7 16 3
do. 4½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	10	10	12½	—	*7 17 0
Telegraph Con.	20	20	38½	—	*6 4 7

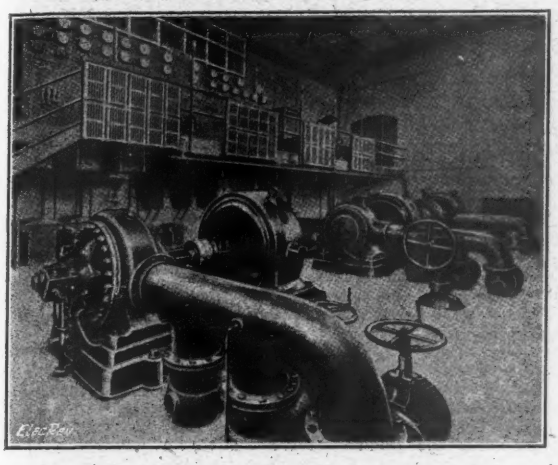
* Dividends paid free of income-tax.

PUMPING PLANT AT PORT ARTHUR, CANADA.

In a paper before the Canadian Society of Civil Engineers, Mr. L. M. Jones recently described the new water supply works of the city of Port Arthur.

The intake consists of duplicate pipes, 24 in. in diameter, extending a distance of 2,350 ft. into the lake, and connected to a pump well at the shore end.

The well is 25 ft. in diameter, and 25 ft. deep.



Interior of the Port Arthur Pumping Station.

The three main pumping units are Escher-Wyss centrifugal, two-stage, single-suction pumps, having a 12-in. suction branch and a 12-in. delivery branch, the horizontal lines of these branches being at the same elevation. They are designed for 2,000 imperial gallons per minute when pumping against a head of 300 ft., the speed being 1,200 r.p.m., and a guaranteed efficiency of 76 per cent. with a 2 per cent. margin. The impellers, guide apparatus, and all parts coming in contact with the water are of special bronze, a nickel steel shaft covered with bronze, self-lubricating bearings of the ring type, and a patent balancing device are fitted. There is no necessity to disconnect piping to gain access to the internal parts. The pumps operate in parallel or in series, as may be desired, and when working in series will deliver the capacity of one pump at twice the head, or a pressure equal to a head of 600 ft. can be obtained if necessary, or a range between 300 and 600 ft. is available by throttling. They will discharge their rated capacity with a suction lift between 19 and 20 ft., and the power required for the stated condition is 244 b.h.p.

The motors are of the Siemens self-starting synchronous type direct connected to the pump shaft, have a power output of 275 h.p., and are capable of sustaining a 25 per cent. overload for a period of two hours.

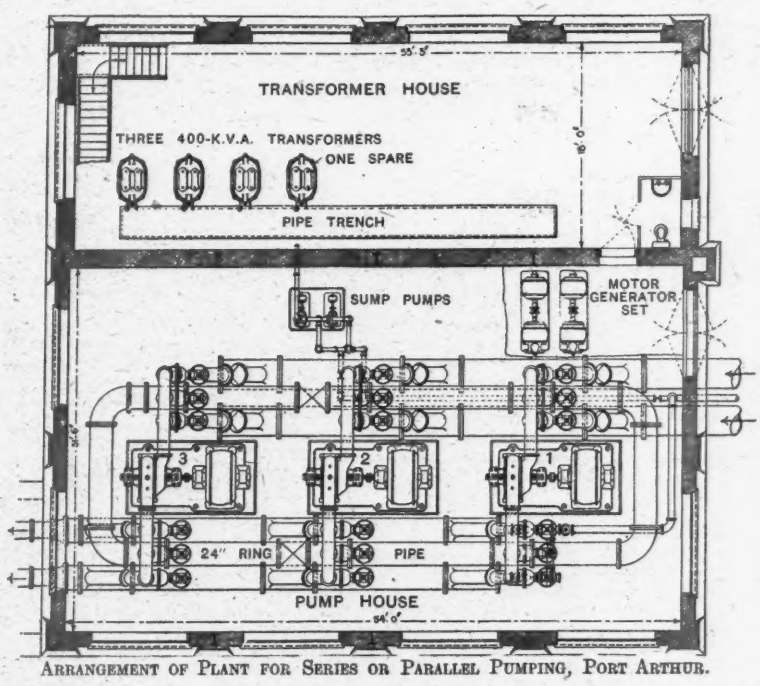
Electrical energy is supplied from the Current River station at 2,200 volts and the Hydro-electric station, the latter at 25,000 volts, to a sub-station adjoining the pump-house, where it is stepped down to 2,200 volts.

On the gallery the switchboard and apparatus is located, there being a panel for each motor, exciter motors, exciters, power line from Current River and the transformers, while alongside the board is the panel for controlling the 25,000-volt line. At the rear of the board the switch and bus compartments are constructed of concrete slabs, there being duplicate sets of bus-bars.

When changing from one source of power to the other, the 400-k.v.a. transformers are paralleled with the Current River line, thus enabling the load to be changed without interruption to the service.

In the transformer station is located a bank of three 400-k.v.a. transformers with one spare, making four in all. They are "star" connected on the high-tension side and "delta" in the low-tension side, being oil and water cooled, and mounted on castors. The switching apparatus is placed on a floor above the transformers, all switches being located in cells made of concrete slabs.

A booster pump, consisting of a motor-driven Allen single-stage pump for 1,000 gallons per minute against a head of 200 ft. is also installed in another part of the system to supply the hill section.



Arrangement of Plant for Series or Parallel Pumping, Port Arthur.

THE PARALLEL OPERATION OF ELECTRIC POWER STATIONS.

By J. S. PECK, M.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers.)

It is not proposed in this paper to discuss the commercial questions involved in linking up, but to point out some of the engineering problems and to indicate what types of apparatus are available, and the conditions under which they may be used.

Fortunately the great majority of stations in this country generate 3-phase current at 50 periods, so that the problem of interconnecting is relatively simple; but there are a number of large systems which generate at other frequencies. The problem of linking-up systems of different frequencies is much more complicated than that of linking-up systems of the same frequency, and each particular case requires careful consideration in order to determine the best method to adopt.

When two alternating-current generators having the same number of poles and the same rating are operated in parallel, they must, of course, run at exactly the same speed, and, if they are to divide the load equally, it is essential that the two engines (or turbines) driving them should have the same speed regulation, *i.e.*, the same drop in speed from no load to full load. If one engine should have a regulation of 2 per cent. and the other of 4 per cent., then (assuming the regulation curve to be a straight line) with full load on one generator there would be only half load on the other. Any two machines may be made to divide the load in any desired proportion by proper adjustment of the steam supply, while adjustments of the field rheostats simply cause wattless current to flow between the generators. The effect of this current is to strengthen the field of the under-excited generator and to weaken that of the over-excited generator; thus the voltage across the two remains equal.

The operation of two or more stations in parallel is simply the operation of two or more groups of generators in parallel, and the conditions are similar to those involved in operating two single generators in parallel, except for the fact that the interconnecting line possesses inductance and resistance. For all ordinary cases the resistance and inductance may be neglected.

When the stations to be linked up have the same frequency, voltage, and phase, the only interconnecting link required is a cable with the necessary switches, &c., for connecting together the bus-bars of the two stations. It frequently

happens, however, that the voltages of the two stations are not exactly equal, and it may be required to vary the voltage of either station independently of that of the other. For this reason it is desirable to have some form of voltage regulator in at least one of the stations; otherwise, when voltage adjustments are attempted, heavy wattless currents will flow between the stations and the voltages on the two systems will remain equal, except for the difference due to the drop of pressure in the cable.

The regulator may be either of the step-by-step or of the induction type.

Fig. 1 shows a diagram of connections which may be used when a step-by-step regulator is adopted. A, A, are series transformers for raising or lowering the voltage of the feeders; B, B, are shunt transformers, the secondaries of which are provided with tappings to give different voltages for applying

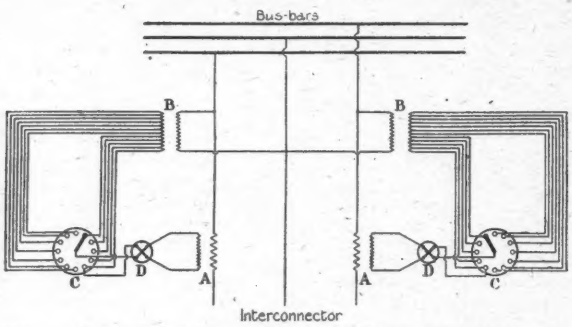


Fig. 1.—Diagram of Connections for Voltage Regulator in Interconnector between Two 3-phase Systems.

to transformers A, A; C, C, are regulating dials; and D, D, are reversing switches. It will be noticed that only two regulators are required for the three phases.

In order to determine the sizes of cable, transformers, and regulator required to interconnect two systems, it is necessary to know the maximum load which will have to be transmitted between them, and as this is the most important feature in parallel operation it will be considered in some detail.

It will be assumed first that the speed regulation of the two systems is identical, so that each will carry its proper proportion of the total load on both systems. This is a justifiable assumption, since the engine governor can usually be adjusted to give approximately this condition.

With two stations A and B, the following cases will be considered:—

1. A and B of equal capacity.
   Unequal loads on the two stations.
2. A of greater capacity than B.
   Load on B greater than its proportion of the total capacity of the stations.
   Load on B less than its proportion of the total capacity of the stations.

1. Since A and B have equal capacities and must run in synchronism they will deliver at all times equal loads. Therefore, if the load on B's bus-bars is greater than that on A's bus-bars, half this difference will be supplied by each station and the connecting feeder must carry half the difference in load.

2. This case will be similar to the preceding one, except that instead of the total load being divided equally between the two stations it will be divided in proportion to their capacities. Knowing the load on the bus-bars and on the generators of each system, the load on the interconnector is known at once.

If the load conditions are known, it is a very simple matter to calculate the load on the interconnecting line. If the loads are steady the engine governors may be adjusted by hand to give the minimum or any other desired load on the interconnector, but where violent fluctuations occur manual adjustments of the governor are impossible, and account must be taken of this fact when designing the interconnecting line.

Where the engine governors of two systems are set for different speed regulations, they will divide the total load not in proportion to their generating capacities, but in direct proportion to their ratings and in inverse proportion to their speed regulation, assuming a straight-line speed drop. Thus, if station A has a rated capacity of 10,000 kw. and B 5,000 kw., while A drops 2 per cent. and B 4 per cent. in speed from no load to full load, the two stations will share the total load in the proportion of $(10/5) \times (4/2) = 4$, *i.e.*, A will deliver four times the load of B. If the regulation of A is 4 per cent. and that of B 2 per cent. then the proportion would be $(10/5) \times (2/4) = 1$, *i.e.*, the two stations would deliver equal loads. This would be a very dangerous condition, as B would be heavily overloaded before full load was reached on A. This simply confirms what is well known in operating machines in parallel, namely, that when the regulation cannot be made equal on two machines, the larger one should have the closer regulation.

The same methods may be used where there are several stations in parallel, and as soon as the loads on the different stations have been determined the loads on the different interconnectors may be found.

In the actual parallel operation of alternators in a station, the loads are seldom divided exactly in proportion to the ratings of the different machines, but shift from one set to another with variations in the external load, depending on the governor adjustments. This causes, however, no trouble in the station so long as the sets share their loads properly at the full output of the station, and hand adjustment of the governors is necessary from time to time. In the operation of stations in parallel exactly the same problems are involved, and there should be no more trouble than in operating different generators in the same station in parallel, provided that the interconnecting link is made of sufficient capacity to take care of any discrepancies in load adjustments due to governor peculiarities.

It is becoming standard practice in all large generating sta-

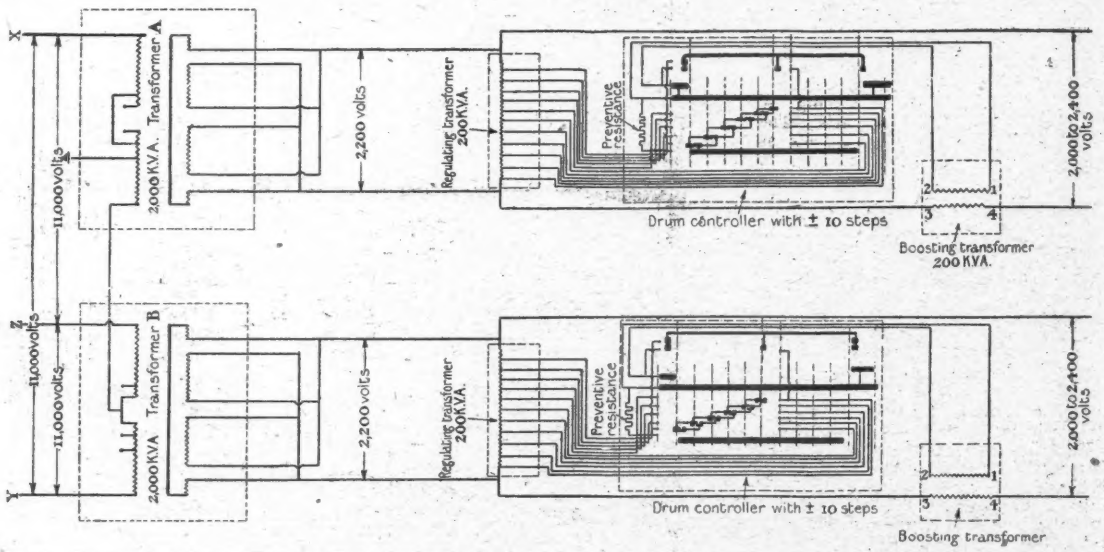


Fig. 2.—Diagram of Connections of Transformers and Regulators in 4,000-kw. Interconnector between 2,200-volt 2-phase System and 11,000-volt 3-phase System in London.

tions to earth the neutral point of the system. Where the bus-bars of two earthed systems are directly coupled together there may be heavy high-frequency currents flowing through earth between the stations, and these currents may cause trouble in telephone and telegraph circuits. There are several ways of overcoming this difficulty:—

(*a*) One station only may be earthed. In this case arrangements could be made so that when the interconnector was opened the unearthed system would be earthed.

(*b*) An insulated earth cable could be run from one system to the earth on the other system, *i.e.*, both systems would have a common earthed point.

(*c*) Transformers could be inserted in the interconnecting line.

(*d*) Reactances or resistances could be placed in the earth connection to limit the earth currents to a negligible value.

Where the stations are of the same frequency but of different phase or voltage, it is necessary to introduce transformers into the interconnector. The voltage and phase transformation is made, where such is required, in the same transformers.

Fig. 2 shows the diagram of connections used for the transformers of a 4,000-kw. interconnector between two stations in London, one generating 2,200 volts 2-phase and the other 11,000 volts 3-phase. For varying the voltage between the two stations step-by-step regulators are used. A drum-type oil-immersed regulator is used for changing from tap to tap.

Apart from the introduction of transformers, the operating conditions for stations having different voltages or phases are exactly the same as when the stations have the same voltage and phase, except where it is required to link up a single-phase system with a 2- or 3-phase system. If it is desired to distribute the load equally on all phases of the 3-phase or 2-phase system, rotating apparatus is required. This may take the form of a motor-generator or of what is known as a phase converter.

Several designs of phase converters have been proposed, but they all utilise the well-known fact that if one phase of a 2- or 3-phase machine be supplied with current and the rotor be brought up to speed, then 2-phase or 3-phase current can be supplied from the terminals of the motor.

This type of converting plant is used on the Norfolk and Western Railway in America for converting the single-phase trolley current into 3-phase current for the motors on the locomotives. When running down grade the 3-phase motors regenerate and supply single-phase current to the trolley through the converter. Similar plant is being installed in the sub-stations of a single-phase railway system for converting from 3-phase to single-phase for supplying the trolley circuit.

When two stations of different frequencies are to be linked up it is necessary to use a frequency changer of the rotating type. This will usually take the form of a motor-generator, but in certain cases where continuous current is required it may be advantageous to use a rotary converter for changing from one frequency to continuous current, and another to change from continuous current to the other frequency. Under this condition it is, of course, possible to use both rotary converters for supplying continuous-current load from the two different systems. This condition will be considered later on.

The cost of a motor-generator is comparatively high, and while it is desirable to keep down its size to correspond to the load which it is desired to transmit from one station to the other, its capacity must also be chosen with reference to the load it may have to transmit under abnormal conditions, and the choice of the type of converting plant will be governed largely by this consideration.

The motor-generator for frequency transformation may be either of the following two types:—

Synchronous motor and synchronous generator—called "synchronous motor-generator."

Induction motor and synchronous generator—called "induction motor-generator."

Each set has certain advantages and disadvantages.

In the case of a synchronous motor-generator, since each machine of the set must run in synchronism with the system to which it is connected, the two systems must run at speeds which are definitely fixed with reference to each other. In other words, the two systems are locked together through the motor-generator, which acts as a perfectly rigid coupling, and it is the strength of this coupling with reference to the loads likely to be thrown on it which requires careful consideration in all cases.

Since the synchronous set locks the two systems in step, the transfer of energy from one system to the other will be governed by the same conditions as when the systems are of the same frequency and paralleled by a direct cable connection. Thus the loads likely to be thrown on the converting set may be calculated in the same way as described above for systems of the same frequency.

Advantages of Synchronous Set.

1. It is reversible and can supply energy in either direction without change from the normal speed ratio.
2. The motoring machine can be run at unity power factor, or even with a leading power factor, and thus assist in improving the power factor of the system. The generating machine may be run with an over-excited field, and so reduce the lagging current carried by other generators on the system.

Disadvantages.

1. The set, acting as a rigid coupling, forces the two systems to run at a fixed speed ratio, and is therefore subject to heavy overloads under certain conditions.
2. Each machine must be synchronised with its own system, an operation requiring some skill, especially with certain ratios between the numbers of poles.
3. Where two motor-generators are operated in parallel special arrangements are required in order to synchronise an unloaded set with one under load.

Where an induction motor and a synchronous generator are used, the induction motor does not run in synchronism with its supply system, but runs slightly below synchronous speed. The slip varies directly with the load transmitted; furthermore, it may be regulated by adjusting the amount of resistance in series with the secondary member. The induction set may be likened to a slipping coupling between two prime movers, where the amount of slip depends on the load transmitted, so that they are not required to operate at exactly the same speed.

The induction-synchronous set is a much more flexible link for coupling-up two power systems than is the synchronous set, and it is possible to use a set of comparatively small capacity for linking-up two large systems, for by making the slip fairly large it becomes almost impossible seriously to overload the set; also it requires a large variation in speeds to give a considerable transfer of energy from one system to the other. On the other hand, the induction machine always takes a wattless current and does not permit any adjustment of power factor on the system to which it is connected.

Advantages of Induction Motor-generator.

1. It is a flexible link and permits a small set to be used between two large systems.
2. It is easier to start and put into operation.
3. By using an adjustable secondary resistance, it is possible manually to control over a considerable range the amount of energy transmitted by the set, though this involves a certain loss in efficiency.

Disadvantages.

1. A comparatively large difference in speed between the two systems is required in order that it may transfer its rated output from one to the other. This large difference in speed often limits the induction set to transmitting in one direction only.
2. The induction machine requires a considerable lagging current, and no power-factor control is possible on this machine without introducing some form of phase advancer.

The great advantages which the synchronous set possesses, of permitting power-factor control and of transmitting energy in either direction without change in speed ratio between the two systems, make it desirable to use the synchronous set in preference to the induction set whenever possible. The great danger in its adoption is the possibility of overloading it and pulling it out of step. Of course, it is possible to protect the machines from excessive overload by means of an overload circuit-breaker; but, when the breaker opens, the machine must be synchronised again, and for a time there is no interconnecting link between the two systems.

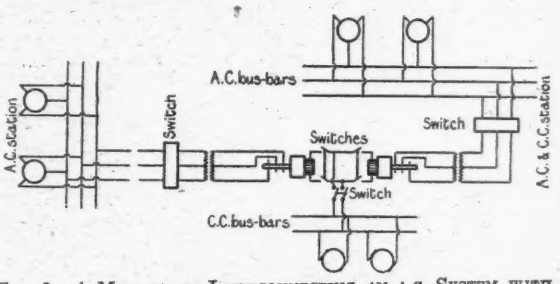


Fig. 3.—A Method of Interconnecting an A.C. System with a Combined A.C. and C.C. System.

In general, a synchronous set should not be used unless its capacity is reasonably large with reference to the smaller of the two stations which it couples together. Where the stations are large and the changes in load comparatively small and not very sudden, it would probably be satisfactory to use a synchronous set having a rated capacity as low as 20 per cent. of the capacity of the smaller station. Under less favourable conditions it might not be advisable to use a capacity less than 40 to 50 per cent. of that of the smaller station. But where the synchronous set is as small as 20 per cent. of the capacity of the smaller station, overload protection must be provided and occasional shut-downs may be expected.

Interconnecting two systems of different frequency by means of rotary converters, in general, is only commercially feasible where continuous current is required in at least one of the stations. Fig. 3 shows two alternating-current stations of different frequency interconnected in this way. From the continuous-current side of the two rotary converters a connection is taken to the continuous-current bus-bars in one of the stations. With this arrangement it is possible to feed the continuous-current bus-bars from either or both alternating-current stations, or to supply alternating current from the continuous-current bus-bars to either or both stations; also it is possible to supply alternating current from either station to the other.

When rotary converters are used the transfer of energy from one station to the other does not depend upon the speed of the generators, but is controlled by manipulating the voltage of the rotary converters, and means must be provided for accomplishing this result. This may be done by synchronous boosters or by transformer tappings, but, in general, reactance control will permit sufficient voltage variation to give the desired results.

In many large continuous-current stations extensions are made at present with turbo plant. Where the units are of considerable size it is customary to use a high-speed turbine and to gear it to a moderate-speed continuous-current gene rator, or else to use a high-speed turbo-alternator and to convert to continuous current through a rotary converter. The latter arrangement offers a ready means of linking up with an alternating-current station should it ever be desired to do so.

With an arrangement such as that shown in fig. 4 it is evident that there are a large number of possibilities with regard to linking-up alternating and continuous current stations.

It is common practice to operate electro-hydraulic systems of the same frequency in parallel, and on the Continent and

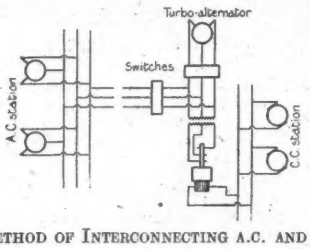


Fig. 4.—A Method of Interconnecting a.c. and c.c. Systems.

in America many large transmission networks are supplied from stations located long distances apart. In Great Britain an increasing number of systems of the same frequency are being operated in parallel, but there has been very little done towards linking-up systems of different frequencies.

In South Wales a 40-cycle system is operating in parallel with a 50-cycle system through two 500-kw. induction motor-generators. One set has a 40-cycle induction motor and a 50-cycle synchronous generator. The other has a 50-cycle induction motor and a 40-cycle synchronous generator. These sets have worked very well in service, except that the heavy wattless currents taken by the induction motors limit the output of the stations and cables. A synchronous condenser is being installed which may work on either system.

In France and in Italy there are some large systems of different frequencies connected through motor-generators, and the author is indebted to Mr. T. Prinetti, of the Società Elettrica Riviera di Ponente, Savona, Italy, for some particulars of a very interesting installation where a synchronous set is used for linking up two very large systems—one of 16⅔ periods and the other of 50 periods. The synchronous set consists of two 10,000-k.v.a. generators, one having 2 poles and giving a frequency of 16⅔ cycles, and the other 6 poles

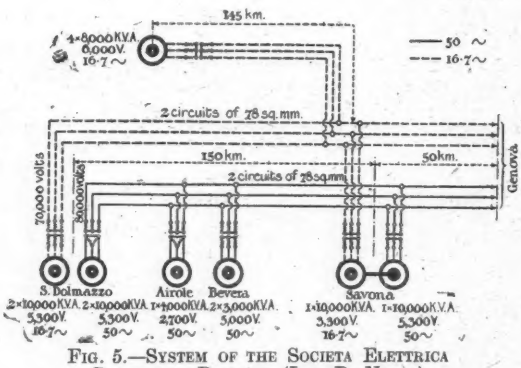


Fig. 5.—System of the Societa Elettrica Riviera di Ponente (Ing. R. Negri).

and giving a frequency of 50 cycles. Fig. 5 shows a diagram of connections, from which the magnitude of the system may be seen. Mr. Prinetti says:—

"Synchronising is usually done by first synchronising the turbine with the 50-period part of the plant, and afterwards with the 16.6-period part, the latter operation being very easy. Only from time to time is it necessary to telephone to other stations to adjust the speed.

"It was not necessary to apply any special device to the regulators of the water-wheels. The regulators are of the 'Riva' oil-pressure type with an hydraulic auxiliary motor."

In this case the two machines are coupled to a steam turbine. The original plan was to use the set for feeding either or both systems, but as coal is now at an almost prohibitive price in Italy, the set does excellent service as a frequency changer.

In two appendices the author shows how to calculate the effect of resistance and reactance upon the parallel operation of alternating-current generators, and the method of calculating the load on an induction-synchronous frequency-changer.

Discussion.

Mr. William Woodhouse, in opening the discussion, while thanking the author for introducing the subject, said he felt that he had passed over altogether too lightly the most important condition, namely, the regulation of power factor. The practical problem was the parallel operation of stations situated some distance apart, usually beyond the economical limit of their present distribution voltage. The justification for interconnection was the added security given to each station or system of distribution and the ability to transfer load at will. The problem, therefore, was almost entirely one of transmission, and the governing conditions were voltage and power-factor regulation; hunting, surges, faults, and other transient conditions must also be considered. The case of interchange between two systems of different frequency was likely to be of decreasing importance because a difference of frequency between two stations in the same area implied that one was non-standard, and, therefore, as development took place the transfer of load would be all in one direction, the non-standard frequency being eventually supplied as a consumer. The condition of most general interest was, therefore, the interconnection of two or more stations working at the same frequency, and he took the author's first example of two systems each with a normal load of 10,000 kw. and with provision for an interchange of 5,000 kw. If each station was dealing with the full local load, the station voltages would be equal, and the two ends of the interconnecting main would be at the same voltage. On the assumption that each load was of the same power factor no current would flow through the interconnector. Assuming that it was desired to transfer from B to A a load of 5,000 kw. and of a power factor of 0.75, and that the impedance voltage of the interconnector was equivalent to 10 per cent. of the line voltage: If B possessed no power of regulating the station pressure and transmission was by means of a main of negligible reactance, the result would be that B's consumers' voltage would drop 10 per cent. This was obviously not permissible, as a necessary condition of the problem was that the consumers' voltage on both systems was kept constant. The voltage of station B must therefore be raised to the normal, which would produce a result dependent entirely on the nature of the transmission line; if the interconnector was without appreciable reactance, the flow of energy would cease; if the interconnector possessed reactance, as in the case of an overhead line, they had an interesting condition, which was that power would only be transmitted from A to B in exchange for idle current from B to A; station B, calling for power, would have to supply (1) Idle current for the load generated by B; (2) idle current for the load supplied by A; (3) idle current for the regulation of the transmission line. Assuming that A supplied half the load on system B, and that the reactance and resistance of the transmission line were equal, the power factor of the load being 0.75, B would require steam power to supply 5,000 kw., and alternator capacity to supply the following wattless k.v.a.:—First, for half its local load, 4,450 k.v.a.; second, for half A's local load, 4,450 k.v.a.; third, for transmission line regulation, 5,000 k.v.a., or 13,950 k.v.a. of idle current in all, equivalent to a power factor on the generators at the receiving station B of 0.33, a figure not only beyond the rating of the machines in use to supply the power load, but beyond that necessary to ensure parallelism. Incidentally, station A would benefit by being relieved of 9,450 wattless k.v.a., and if its output was originally equal to that of B, the power factor of the load carried by A's generators would become practically unity. This condition of affairs was equally as unpractical as the first assumed, and they must consider again from the transmission point of view what practical steps could be taken to correct it. There were several ways: First, the reduction of the percentage voltage drop in the transmission line, by increasing either the amount of copper or the transmission voltage; second, the use of regulating transformers or of boosters; third, the use of synchronous condensers. There was a definite limit to the improvement effected by increasing the amount of copper, as it only dealt with resistance drop, and not at all with the inefficiency of transmitting wattless k.v.a. from one centre to another. Furthermore, if the interconnection was by means of cables, the use of regulating transformers or boosters or the introduction of reactance became essential. The increase of the transmission voltage was another matter which should be considered in connection with the proposed use of existing 6,000-volt mains for linking-up. The use of regulating transformers presented certain practical disadvantages if frequent changes of load were to be met; to return to the case just considered, a regulating transformer at station A giving a 10 per cent. boost would reduce the call on B for idle current, but would still involve transmission at a low power factor; that was to say, the energy lost in transmission would be 62 per cent. greater than if the load was transmitted at unity power factor. Furthermore, unless the transformer was automatic, the interchange of idle current on large variations of load such as occurred regularly in power supply might be unsatisfactory. For large loads regulating transformers were not strongly to be recommended. If existing networks were to be used for interconnection, it was probable that load would be distributed at various points along the interconnector, which would limit the amount of boosting permissible, and would probably require a transformer at each end. Synchronous boosters in

conjunction with synchronous condensers might form an advantageous alternative to regulating transformers. Synchronous condensers as a means of regulation dealt with power factor and voltage; it was important to remember that if the voltages at the two ends of a transmission line were adjusted to be constant and equal at any load, they would remain so at all loads, and the power factor would be constant also. Obviously, if station B was being aided, the synchronous converter should be at B, dealing with the idle current near its source; if A was being aided, the synchronous converter should be at A, so that for mutual aid of, say, 5,000 K.V.A. at 0.75 power factor, they would require two machines each of 3,300 K.V.A., a somewhat substantial additional cost to that of interconnecting mains. Their power consumption must also be borne in mind, as though efficient at full load, a synchronous motor had rather high no-load losses; the running arrangements had, therefore, to be studied carefully. As an off-set, however, it must be remembered that the use of synchronous converters would reduce the K.V.A. loading on the generators, thus not only enabling smaller generators to be used for a given KW. output, but reducing the stresses on them in the case of faults; further, such machines helped to balance unequally-loaded phases. Broadly speaking, so far as voltage regulation was concerned the first condition for a satisfactory solution of the problem was a high transmission pressure; when national interconnection came, they might look for a transmission system of, say, 60,000 volts, a power distribution voltage of anything between 10 and 30,000 volts, and the relegation of the 6,000-volt systems to domestic supply. As to power factor, a satisfactory voltage at the consumers' terminals made auto-regulation at each station a necessity. The use of auto-pressure regulators for power factor control presented no practical difficulty, as the relationship between power factor and pressure drop in an inductive line was almost a straight line. On the Yorkshire system, as a case in point, they had two stations 14 miles apart running in parallel, each fitted with auto-pressure control, which effected the desired result for power factor also. Obviously, the interchange of power between any stations should be at as high power factor as possible, so as to reduce transmission losses; with fixed setting of the regulators it was possible to arrange for this within practical limits. In the case mentioned, the normal condition was that little power was interchanged, the interconnectors acting also as distributors. As a large interchange was infrequent, the comparative value of low line losses was small and, therefore, the necessary transfer of power was carried out by power factor alteration at the expense of the wattless K.V.A. on the receiving station; failing the provision of a synchronous converter, this could be dealt with by running a generator as a motor. Finally, in this country the case to be met was that of a number of stations interconnected for the sake of security and load transfer, but under separate control. No system of operation would prove satisfactory which involved communicating instructions to all the stations when a change of load occurred, and the simplest possible alternative was automatic pressure regulation, station output controlled by steam pressure, and either central or sectional regulation of wattless K.V.A. by means of synchronous condensers and boosters.

Mr. Partridge said he had anticipated that the paper would have dealt at greater length on the apparatus which might be used. It was impossible to say what would be the prime mover of the future, but it must be designed for parallel working. As regarded transmission, he saw no difficulty in working up to 50,000 volts with underground cables. The most important question was as to the periodicity to adopt, and this should be settled once for all. It appeared to him that it would be better to adopt something lower than 50; a low periodicity meant less inductance, less chance of coming out of step, the regulation was much better, and capacity currents would be less; pressure rises would also be smaller, and switching would be easier if oil switches were used owing to the zero remaining longer. It was necessary to have plenty of copper in the interconnecting cable. He much preferred the induction regulator for voltage adjustment, and regretted that the paper said so little about phase converters. The induction motor-generator was preferable to the synchronous machine; his experience of a large set for coupling a 3-phase, 25-cycle, 7,000-volt system to a single-phase, 85-cycle, 10,000-volt system was most satisfactory despite heavy disturbances on one or two occasions. He pointed out that while it was easy to synchronise the first induction machine, there was a difficulty with the second incoming machine on account of the difference in slip, and a somewhat similar difficulty arose with the second synchronous motor generator.

Mr. A. M. Taylor agreed with Mr. Woodhouse as to linking-up being more complex than appeared on the surface. In Birmingham, the old generating station, run with automatic regulation, was coupled to a new plant without such regulation, and the preliminary difficulties had been overcome, but he thought the author rather under-estimated the difficulty of synchronising two large stations, and that he should have included reactance. The capacity of switchgear was very much governed by it, and it was possible that with two 30,000-KW. stations near and connected that an unsafe amount of plant would come on to one system unless reactance was employed. In regard to the possibility of paralleling stations through static frequency changers, he was quite prepared to design frequency changers of at least 300 KW. capacity. A "bank" of, say, 10 such frequency changers, representing a total of 3,000 KW., could be suddenly switched in as a big unit. It would not be necessary to synchronise nearly so closely as with synchronous frequency changers, and probably an error of 60 deg. "lag" or "lead," or, at a pinch, even 90 deg., would not be attended with serious trouble. For this reason it might be possible to put in a 3,000-KW. "bank" of static transformers, where a 6,000 or 9,000-KW. set would be necessary with rotating frequency changers. Within certain limits the apparatus would be reversible, possibly to the extent of the capacity of the apparatus. The large "lagging" current, which was the worst feature of the static transformer, could be compensated by phase advancers at the station, as proposed for the induction motor-generator scheme. The static frequency changer took a perfectly balanced current from the three mains, and delivered it to a single-phase system on the higher frequency. All the above remarks related to step-up transformation from 25 periods to 75 (or from 16.6 to 50) periods, but he had also obtained entirely satisfactory experimental results with a step-up from 25 cycles to 50 cycles, for which, however, direct-current excitation would be required. He had experimentally performed the stepping down of the frequency from 75 to 25 (or 50 to 16.6) periods, and probably the same could be done with stepping down from 50 to 25. If, however, the apparatus was found to be sufficiently reversible (so long as the 25-period supply did not entirely give in), there seemed to be no object in employing special transformers to act independently of that supply. He thought that the simplicity of the static frequency changer, and the ease with which it could be switched into circuit under almost all sorts of conditions, and the fact that it practically required no attention when once switched in, being capable of very heavy overloads, and being self-protective against rises of pressure on either side or short circuits rendered it almost ideal for use as a piece of interlinking apparatus.

Sir Charles Parsons, who said he had not intended to speak, referred to the great interest of the paper in view of the necessity of facilitating electricity supply for industrial purposes. He wished the author had said more about American developments, although, probably due to our restricted area, more linking-up was in prospect here. He went on to refer to possible developments in prime movers, pointing out the limitations of the gas engine in this respect.

Mr. Brazil said it was important to consider safety as well as efficiency in choosing apparatus for interconnecting sources of electricity supply. He strongly favoured the synchronous motor-generator because of the importance of being able to transmit in both directions. The induction motor-generator would do this under certain conditions, but not unless there was synchronous plant running. Rotary converters were more efficient, but the question of safety came in with them. As regarded earthing the neutral (*a*) involved using apparatus likely to go wrong, (*b*) was ideal, but expensive, and (*d*)—the use of resistances, &c., to limit earth currents—was, he thought, the best arrangement.

Mr. A. P. Trotter said there were three points of view in regard to earthing: That of the supply engineer, who considered the triple-frequency currents if earthing was carried out at more than one point; that of the Post Office engineers, who had charge of telegraph and telephone circuits; and the question of safety. They must have sufficient current to trip an overload circuit breaker, or, better still, a protective device. The frequencies at present in use in this country were as follows:—

Electrical Supply Undertakings.

Frequency.	Stations.	Thousands of KW.
25	10	93
40	20	156
50	161	760
60	9	17
83	5	35
100	15	45
33, 68, 75 77, 80, 90, 93	10	11

Electrical Power Companies.

25	4	78
40	3	317
50	8	117
60	1	36

The commonest frequency in the case of electrical supply undertakings was 50, and the KW. so supplied exceeded twice the whole of the remainder. In the case of power companies, a frequency of 50 was used by eight out of 16, but more power was supplied at 40 than all the rest put together. This was no argument for the extension of a frequency of 40 outside the district known as the North-East Coast; if this were excluded, 50 was the most common. It was undesirable that tees or sub-stations should be connected in linking mains; these should ultimately form a network, and a frequency of 25 seemed suitable. Regulation B.4 of the Extra-high-pressure Regulations of the Board of Trade had, for more than 10 years, restricted frequencies to 25 or 50, except in the North-East Coast district.

Mr. W. M. Mordey said there was no greater bugbear in power supply work than low power factor, and he had looked for some improvement in this by the use of the static condenser, to the advantages of which, including decreased loss, lower cost, and stationary construction, he had drawn the attention

of the Institution some eight years previously. He was much disappointed to find that they had not come into greater use, and suggested that they were worth consideration by engineers.

Mr. E. T. WILLIAMS said a great deal had been said about interconnection, but he agreed that the matter would require careful handling, or it would lead to a waste of money. He felt that they should settle now what should be the standard frequencies. It was easy to imagine a district trunk main system with a standard frequency, to which adjacent stations would be connected, and it was important to fix the frequency and pressure now rather than later.

Mr. J. S. PECK, in replying to some of the points raised, said he felt that Mr. Woodhouse had over-estimated the difficulties of parallel operation; many stations were operating successfully in parallel in ordinary work. In regard to the Manchester district, it had not been considered necessary yet to use more than 6,000 volts for interconnecting service. Low frequency was an advantage as regards transmission, but the difficulty arose in regard to large generating sets which were restricted in speed. It was probable that larger sets would be built for a speed of 3,000 R.P.M. Quite a small current was sufficient to trip the protective gear for earthing. If very large systems were interconnected, it would probably be necessary for the sake of the switchgear to use reactance, and he did not anticipate any great difficulty in parallel working. The difficulties in linking-up were over-estimated.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

UNITED STATES OF AMERICA.—In the United States Revenue Act, which has recently been passed by Congress, provision is made for the creation and establishment of a Commission, to be known as the United States Tariff Commission, which is to be charged with the duty of investigating the administration and fiscal and industrial effects of the U.S. Customs Laws, the relations between the rates of duty on raw materials and finished or partly finished products, the effects of *ad valorem* and specific duties and of compound specific and *ad valorem* duties, all questions relative to the arrangement of schedules and classification of articles in the several schedules of the Customs law, and, in general, to investigate the operation of Customs laws, including their relation to the federal revenues, their effect upon the industries and labour of the country, and to submit reports of its investigations.

The Commission is to have power to investigate the tariff relations between the United States and foreign countries, commercial treaties, preferential provisions, economic alliances, the effect of export bounties and preferential transport rates, the volume of importations compared with domestic production and consumption, and conditions, causes, and effects relating to competition of foreign industries with those of the United States, including dumping and cost of production. The Commission is also to have power to investigate the Paris Economy Pact and similar organisations and arrangements in Europe.

The Revenue Act also contains provisions dealing with "unfair competition," of which the following may be worthy of mention:—

ex Section 801.—"That it shall be unlawful for any person [in which term are included partnerships, corporations, and associations] importing or assisting in importing any articles from any foreign country into the United States, commonly and systematically to import, sell or cause to be imported or sold such articles within the United States at a price substantially less than the actual market value or wholesale price of such articles, at the time of exportation to the United States, in the principal markets of the country of their production, or of other foreign countries to which they are commonly exported, after adding to such market value or wholesale price, freight, duty, and other charges and expenses necessarily incident to the importation and sale thereof in the United States: *Provided*, That such act or acts be done with the intent of destroying or injuring an industry in the United States, or of preventing the establishment of an industry in the United States, or of restraining or monopolising any part of trade and commerce in such articles in the United States."

Section 802.—"That if any article produced in a foreign country is imported into the United States under any agreement, understanding, or condition that the importer thereof or any other person in the United States shall not use, purchase, or deal in, or shall be restricted in his using, purchasing, or dealing in, the articles of any other person, there shall be levied, collected, and paid thereon, in addition to the duty otherwise imposed by law, a special duty equal to double the amount of such duty: *Provided*, That the above shall not be interpreted to prevent the establishing in this country on the part of a foreign producer of an exclusive agency for the sale in the United States of the products of said foreign producer or merchant, nor to prevent such exclusive agent from agreeing not to use, purchase, or deal in the article of any other person, but this proviso shall not be construed to exempt from the provisions of this Section any article imported by such exclusive agent if such agent is required by the foreign producer or if it is agreed between such agent and such foreign producer that any agreement, understanding or condition set out in this Section shall be imposed by such agent upon the sale or other disposition of such article to any person in the United States."

NEW PATENTS APPLIED FOR, 1916.

(NOT YET PUBLISHED).

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & CO., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

16,215. "Sparking plugs for internal-combustion engines." W. A. CLARK, SPHINX MNFG. CO., H. G. LONGFORD & W. W. LONGFORD. November 13th.

16,248. "Sparking plugs." SOC. CLERGET, BLIN ET CIE. November 13th. (France, November 13th, 1915.)

16,250. "Regulating mechanism for controlling speed of induction motors." BRITISH THOMSON-HOUSTON CO. (General Electric Co., U.S.A.). November 13th.

16,272. "Electric regulators, &c." H. LEITNER. November 14th.

16,284. "Electrical connections and terminals." H. M. ACKERY. November 14th.

16,291. "Reversing switch." IGRANIC ELECTRIC CO. & F. BERGMANN. November 14th.

16,294. "Packing boxes for electric lamp bulbs." A. ASTLEY. November 14th.

16,308. "Secondary electric batteries." T. A. D. LAWTON. November 14th.

16,332. "Contact breakers of magnetos." A. COX & ELECTRIC IGNITION CO. November 15th.

16,348. "Electric wire gas-lighting appliance." J. H. T. ROBERTS. November 15th.

16,359 & 16,360. "Electrical contacts, and mounting or supporting same." A. CRAWFORD, W. PRESTON AND W. SANDERS & CO. November 15th.

16,370. "Telegraphy." W. M. BRUCE. November 15th.

16,382. "Electric switchgear." H. W. CLOTHIER AND A. REYROLLE & CO. November 15th.

16,393. "Electric heaters." T. BURNEY. November 16th.

16,395. "Electric furnaces." V. STOBIE. November 16th.

16,413. "Manufacture of switchboards." W. N. RINGROSE. November 16th.

16,423. "Sparking plugs." R. HENRY & E. HERRMANN. November 16th. (France, December 2nd, 1915.)

16,427. "Electric arc devices and method of operating same." BRITISH THOMSON-HOUSTON CO. (General Electric Co., U.S.A.). November 16th.

16,434. "Signalling by electric lamps." W. S. G. BAKER, MCKENZIE, HOLLAND & WESTINGHOUSE POWER SIGNAL CO. November 16th.

16,452. "Mercury breaks or interrupters." F. R. BUTT & CO. AND F. R. BUTT & H. F. BIGGE. November 16th.

16,453. "Protective devices for electric circuits." W. J. MELLERSH-JACKSON (Barnch Electric Controller Corporation). November 16th.

16,457. "Reflectors for high-speed submarine cable telegraphy." T. B. DIXON. November 16th. (U.S.A., July 19th, 1915.)

16,461. "Attachment for trolley poles of electric cars." W. JAMES. November 17th.

16,492. "Spark gaps." L. A. KUNZMAN. November 17th.

16,512. "Ignition dynamos." C. T. MASON. November 17th. (U.S.A. June 19th, 1915.)

16,513. "Ignition dynamos." C. T. MASON. November 17th. (U.S.A., June 19th, 1915.)

16,514. "Ignition dynamos." C. T. MASON. November 17th. (U.S.A., June 19th, 1915.)

16,518. "Ignition dynamos." C. T. MASON. November 17th. (U.S.A., June 19th, 1915.)

16,521. "Sparking plugs." H. BIRKBECK (Thierry & Co.). November 17th.

16,536. "Miners' electric safety lamps." O. OLDHAM. November 17th.

16,540. "Brush-lifting and short-circuiting device on induction motors, &c." BRUSH ELECTRICAL ENGINEERING CO. & T. H. HURST. November 18th.

16,542. "Method of generating combustive forces by electrolysis of water for use in internal-combustion engines." G. C. COLONA & D. MAITLAND. November 18th.

16,563. "Wireless signalling systems." BRITISH THOMSON-HOUSTON CO. (General Electric Co., U.S.A.). November 18th.

16,566. "Apparatus for producing perforated strip by electrical current impulses." H. H. HARRISON AND CREED, BILLE & CO. November 18th.

16,567. "Apparatus for producing perforated strip by electrical current impulses." H. H. HARRISON AND CREED, BILLE & CO. November 18th.

16,575. "Pocket or portable electric lamps." E. BIGMORE & W. R. CURTIS. November 18th.

PUBLISHED SPECIFICATIONS.

1915.

13,852. MEASURING INSTRUMENTS, RELAYS, AND THE LIKE. Marconi's Wireless Telegraph Co. & H. A. Ewen. September 29th. (Cognate applications, 3,233/16 and 3,780/16.)

15,092. DIRIGIBLE TORPEDOES. H. A. Von Post. October 25th.

15,094. ATTACHMENT FOR MINERS' ELECTRIC SAFETY LAMPS FOR DETECTING FIREDAMP AND OTHER COMBUSTIBLE GASES. T. J. Thomas. October 26th.

15,237. WIRELESS SIGNALLING SYSTEMS. British Thomson-Houston Co. (General Electric Co., U.S.A.). October 28th.

15,261. AUTOMATIC APPARATUS FOR EXTINGUISHING THE LIGHT FROM PORTABLE ELECTRIC LAMPS IN PREDETERMINED DIRECTIONS. L. Gaster & J. S. Dow. October 29th.

15,370. ELECTRIC CLOCKS. H. E. Warren. November 1st. (November 30th, 1914.)

15,759. CATHODE FOR ELECTROLYTIC CELLS. F. G. Wheeler. (January 25th, 1915.) November 8th.

17,752. METHOD AND MEANS OF INDICATING OR RECORDING THE FREQUENCY OF PERIODIC CURRENTS. N. C. F. Jensen. December 20th.

1916.

The numbers in brackets are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

18. VIBRATORY MASSAGE APPARATUS. E. Peckham. January 3rd, 1916. [101,890.]

869. ELECTRICAL RELAY SYSTEMS. Siemens & Halske Akt. Ges. April 10th, 1915. (Patent No. 100,262.)